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DUSTING WITH SULPHUR FOR THE CONTROL OF LEAF AND STEM RUST OF WHEAT IN MANITOBA†

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WINNIPEG FORTIETH-ACRE PLOT EXPERIMENTS

The experiments of this type, which have been carried on during the last two years here, have established * the effectiveness of sulphur dust in controlling leaf and stem rust of wheat and have told us something as to the limits of the effectiveness of this method of rust control under the conditions of the experiments. However, the feasibility of sulphur dusting as a practical method of controlling rust depends partly on whether comparable results can be obtained by the same procedure in different years. For this reason the fortieth-acre plot experiments, dealing with the effectiveness of various rates and frequencies of dusting, were extended and repeated this year. Additional experiments were included to determine the influence of (1) the time at which dusting was begun, in relation to the stage of development of the rust epidemic and (2) the addition of an oxidizing agent to the sulphur dust.

EXPERIMENTAL METHODS

A field of heavy clay loam, on which corn was grown last year, was sown with Marquis wheat on June 10th. About a month after sowing, the field was divided into fortieth-acre plots, which were separated from each other by three-foot pathways. The plots were laid out in long narrow rectangles 136 feet by 8 feet and this made it possible to dust them thoroughly from the pathways without injuring the stand.

The dusting was all done with a hand duster of the blower-gun type (Plate 1). With such a duster it was not possible to apply a specific rate of application, such as 15 or 20 lbs. of dust per acre, with absolute accuracy, but it was found that a satisfactory approximation to any desired rate could be obtained. The Niagara Sprayer Company's Kolo-dust was used throughout the experiments.

Dusting was begun on July 18th, at which time only a light scattered infection of leaf and stem rust was to be found. Final data on leaf rust infection were taken on August 24th and the percentage of stem rust infection was read on September 13th. In each case the percentages of infection were determined by Dr. Margaret Newton and Mr. T. Johnson without their knowing the treatment which had been given to the various plots.

*See Report of Dominion Botanist for the years 1925 and 1926.

†Contribution from Division of Botany, Experimental Farms Branch, Department of Agriculture, Ottawa, Canada.

Soil moisture was abundant throughout the season and a rank, succulent growth developed. Extremely heavy epidemics of both leaf and stem rust occurred and this combined with the lateness of the crop to make the test unusually exacting.

Eight undusted check plots were scattered through the 40 plots in such a way that each plot was touching a check at least on one corner.

Yield results were secured by harvesting and threshing 3 rod rows selected at random from each plot. The weight per bushel was determined as well as the yield per acre and the threshed samples were graded for quality according to the Dominion Government standards by Prof. T. J. Harrison.

Experimental Results

I. Relative Efficiency of Different Rates and Frequencies of Dusting

Four plots were dusted with 15 lbs. of Kolo-dust per acre, one at each of the following frequencies—once every two weeks, and once, twice and three times per week. Four other plots were dusted at the same intervals but at the rate of 30 lbs. Kolo-dust per acre instead of at 15. A third series was dusted with the same frequencies but at the rate of 45 lbs. Kolo-dust per acre. Dusting was commenced on all three series on July 18th and was continued until September 9th, when the crop was practically mature.

Table 1. ***Results of dusting wheat with sulphur. Influence of the rate and frequency of applications on rust infection, yield, and quality of grain.***

Applications of Sulphur Dust			Percentage infection			Yield and Quality Results			
Rate lbs. per acre	Frequency Number per week	Total number	Leaf Rust	Stem Rust		Weight in gms. per rod row	Weight per measured bushel	Canadian Government Grade	Yield per acre in bushels
			Average	Range	Average		lbs.		
Checks*	0	0	62	60–95	87	62.9	45	Feed	12.2
15	Fortnightly	4	42	50–85	75	79.6	46	Feed	15.4
15	1	8	32	25–45	35	173.6	54	5	33.4
15	2	16	22	20–45	30	172.0	56	4	33.3
15	3	24	21	10–30	20	207.3	60	3N	39.2
Checks*	0	0	62	60–95	87	62.9	45	Feed	12.2
30	Fortnightly	4	53	40–75	65	80.6	48	Feed	15.5
30	1	8	30	20–60	35	106.6	54	5	20.6
30	2	16	20	5–20	15	157.3	53	5	30.5
30	3	24	20	tr–15	8	220.0	54	5	42.6
Checks*	0	0	62	60–95	87	62.9	45	Feed	12.2
45	Fortnightly	4	30	30–70	50	124.6	51	6	24.7
45	1	8	25	25–50	35	124.3	55	5	25.0
45	2	16	25	5–15	10	172.6	53	6	33.4
45	3	24	15	tr-8	4	252.3	56	5	48.9

* Average of eight undusted plots.

The results of this experiment are summarized in Table 1 and presented graphically in Figs. 1-4. Taken as a whole these results are a striking confirmation of those obtained previously and indicate conclusively

Fig 1.

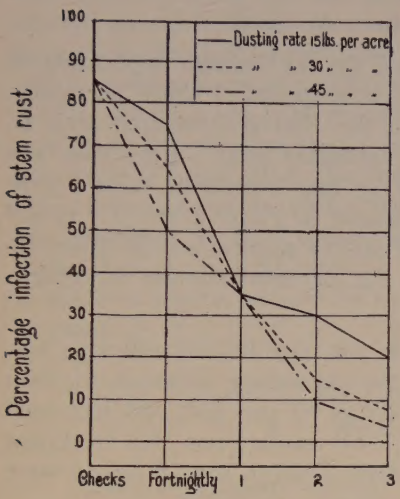


Fig 3.

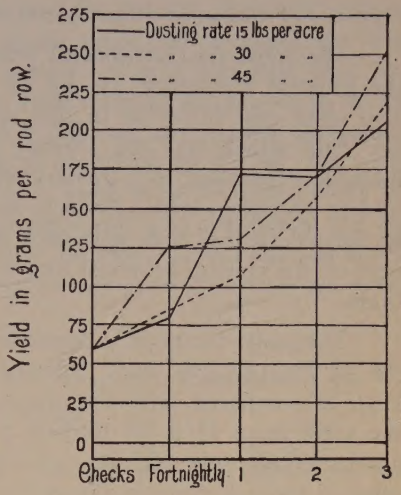


Fig. 2.

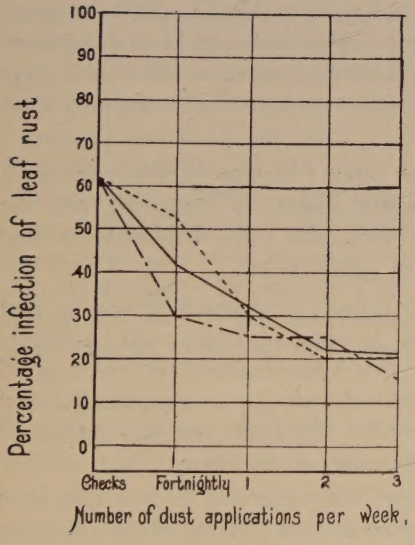
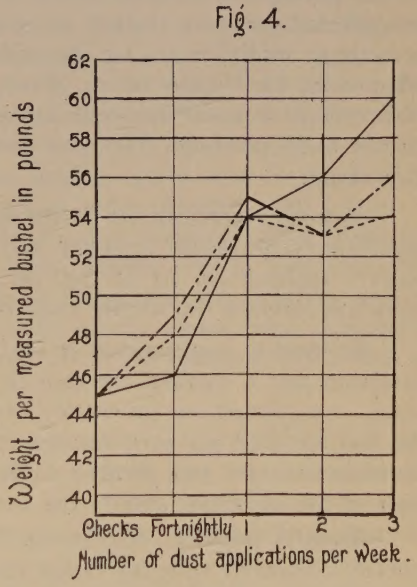


Fig. 4.



FIGURES 1 and 2. The relation between the rate and frequency of application of sulphur dust and the percentage infection of (1) stem rust and (2) leaf rust.

FIGURES 3 and 4. The relation between the rate and frequency of application of sulphur dust and (1) the average yield of one rod row from each plot and (2) the weight per measured bushel of the threshed grain of each plot.

that, if sulphur is applied in sufficient amounts and with sufficient frequency, it can be relied on to control effectively both leaf and stem rust of wheat, even under the most favorable conditions for rust attack.

The most perfect control was achieved by the heaviest application at the greatest frequency, i.e. by 45 lbs. per acre applied 3 times per week. The stem rust infection in this case was 4 per cent as compared with 87 per cent, which was the average of eight undusted plots. Leaf rust was likewise controlled to a remarkable extent by this treatment. The degree of leaf and stem rust control is clearly indicated in Plates 2 and 3. It will be noticed further that, with each particular rate of application, the effectiveness of the control achieved increased with the increased number of applications.

The only fortnightly application which was significantly effective was the 45 lbs.-per-acre one. This decreased the percentage infection of stem rust, as compared with the checks, from 85 to 50 per cent and increased the yield from 11 to 24 bushels per acre. The results from this treatment compare favorably with the weekly applications (except the 15 lbs.-per-acre one) in yield, but not in the reduction in percentage infection.

Weekly applications gave consistent results and were surprisingly effective in controlling rust and increasing yield. The yield in the case of the 15 lbs.-per-acre application (33.4 bus. per acre) has almost certainly been exaggerated by some factor other than rust control. Judging from the percentage infection among the weekly applications, 15 lbs. per acre is as effective as the heavier ones. However, since this plot was located between plots which received frequent heavy applications, some of the result may be due to its position. Hence it does not seem wise to base conclusions on this result.

Bi-weekly applications at the heavier rates (30 and 45 lbs. per acre) significantly decreased infection and increased yields, as compared with the weekly applications. At 15 lbs. per acre there was little difference in rust infection between the weekly and bi-weekly applications.

Tri-weekly applications at each rate caused a sharp decrease in rust infection and a marked increase in yield, as compared with the bi-weekly ones. As pointed out previously, it was with 3 applications per week at 45 lbs. sulphur dust per acre that the most perfect rust control and the greatest increase in yield was secured. Therefore, if the most perfect control of rust is the objective, this is the best treatment of all those tried.

From a practical standpoint, however, the objective is not the most perfect control of rust, but rather that degree of rust control which combines with the cost of achieving it so as to give the greatest net return from the operation. It is interesting to look at the results from that point of view and to attempt to choose the treatment which promises the best practical results. In comparing these results, wherever the yield is inconsistent with the percentage infection, the rust reaction should be considered in preference to yield, since the plots were not replicated. The cost of carrying out any treatment, requiring three applications of dust per week for a period which

in Manitoba will probably average five or six weeks, will certainly be prohibitive. Two applications per week might possibly be applied, but they are to be considered only if the results obtained thereby are decidedly better than those obtained by one application per week. This matter cannot be decided definitely from the available data and in general use may perhaps have to be decided in each case by the means employed to apply the dust and the environmental conditions which prevail. For a bad rust year like 1927 it would seem from these data that two applications per week at the rate of 30 lbs. per acre should be applied if possible and, if one application per week is being used, the rate should be increased to 45 lbs. per acre. It is obvious, however, that a great deal more work must be done before we can generalize on what constitutes the optimum rate and frequency for the most effective practical control. It may even be that this can only be stated in terms of a particular season and that satisfactory generalizations can never be made.

2. The Influence of the Time at Which Dusting is Commenced on the Control Achieved.

In the experiments already described, dealing with the effect on rust control of different rates of application and different frequencies of dusting, the first application was made on July 18th, at which time only a very light scattered trace of rust had appeared. Further experiments were undertaken to determine whether equally satisfactory control could be achieved if dusting were commenced at various stages later in the development of the rust attack. Accordingly, dusting was commenced on July 25th on a series of three plots, which were dusted subsequently at the rate of 15 lbs. of dust per acre, once, twice, and three times per week respectively, until September 9th. At this time 40 per cent of the plants were carrying an infection ranging from a trace to 5 per cent. A second similar series was dusted first on August 8th when 90 per cent of the plants were infected with a trace to 20 per cent infection. On August 15th another series of three plots was dusted at the rate of 45 lbs. per acre. From August 15th to September 9th, these three plots were dusted at the following frequencies—fortnightly, weekly, and bi-weekly. By August 15th practically all the plants were infected in undusted plots. Stem rust ranged from 30 to 45 per cent while that of leaf rust was from 50 to 55 per cent.

The results of these experiments are summarized in Table 2 and presented graphically in Figs. 5-8. It will be noticed that the earliest series, which was dusted first on July 18th, gave very much better results throughout all the different frequencies of dusting and rates of application than did any of the later series. Even in the second series, in which dusting was started only a week later than the first, it required three applications per week to achieve the same measure of control as was achieved by weekly applications in the earlier series. In the very late series, which was dusted first on August 8th, the application of 45 lbs. sulphur dust twice per week failed to produce significant results.

TABLE 2. *Results of dusting wheat with sulphur. Influence of time of initial application on leaf and stem rust infection, yield, and quality of grain.*

Date of initial application	Dusting Period—July 18th–September 9th			Percentage infection —			Yield and Quality Results			
	Rate of application	Frequency of application Number per week	Total number of applications	Leaf Rust	Stem Rust		Weight in gms. per rod row	Weight per measured bushel	Canadian Government Grade	Yield per acre in bushels
				Average	Range	Average				
July 18	15	1	8	32	25–45	35	173.6	54	5	33.4
July 25	15	1	7	45	40–80	65	136.0	51	6	26.4
Aug. 8	15	1	5	40	40–70	65	92.6	49	Feed	17.9
Checks*	0	0	0	63	50–95	87	62.9	45	Feed	12.2
July 18	15	2	16	22	20–45	30	172.0	56	4	33.3
July 25	15	2	14	45	35–60	45	127.0	54	5	24.6
Aug. 8	15	2	10	60	36–75	60	69.6	47	Feed	13.5
Checks*	0	0	0	63	50–95	87	62.9	45	Feed	12.2
July 18	15	3	24	21	10–30	20	207.3	60	3N	39.2
July 25	15	3	21	45	20–40	30	164.3	57	4	31.8
Aug. 8	15	3	15	45	25–60	40	169.3	54	6	32.8
Checks*	0	0	0	63	50–95	87	62.9	45	Feed	12.2
July 18	45	Fortnightly	4	30	30–70	50	124.6	51	6	24.1
Aug. 15	45	Fortnightly	2	62	40–80	65	81.3	45	Feed	15.8
Checks*	0	0	0	63	50–95	87	62.9	45	Feed	12.2
July 18	45	1	8	25	28–50	35	129.3	56	5	25.0
Aug. 15	45	1	4	65	40–75	65	69.6	44	Feed	13.5
Checks*	0	0	0	63	50–95	87	62.9	45	Feed	12.2
July 18	45	2	16	25	5–15	10	172.6	53	6	33.4
Aug. 15	45	2	8	60	40–90	65	73.6	46	Feed	14.3
Checks*	0	0	0	63	50–95	87	62.9	45	Feed	12.2

* Average of eight untreated check plots.

Fig. 5.

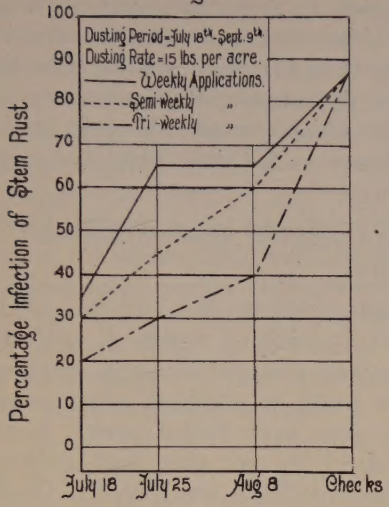


Fig 7.

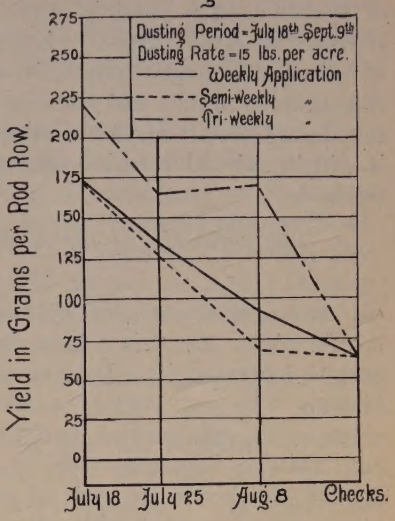


Fig 6.

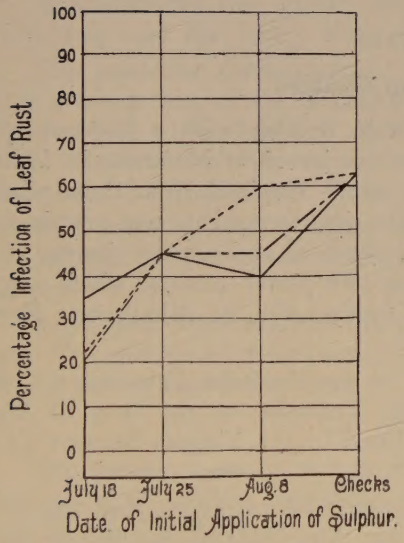
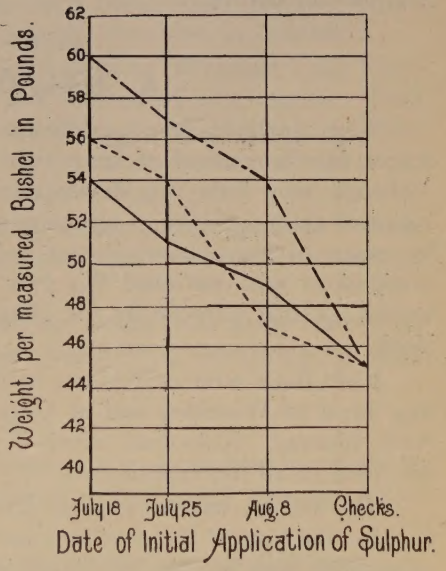


Fig 8.



FIGURES 5 and 6. Influence of the time of initial application of sulphur dust at the rate of 15 lbs. per acre, and at different frequencies, on the percentage infection of (1) stem rust and (2) leaf rust of wheat.

FIGURES 7 and 8. Influence of the time of initial application of sulphur dust at the rate of 15 lbs. per acre, and at different frequencies, on (1) the average yield of one rod row from each plot and (2) on the weight per measured bushel of the threshed grain of each plot.

These results emphasize the importance of making the first application of dust as soon as possible after rust first appears. Apparently early dusting prevents the accumulation of large amounts of inoculum and makes the control of rust subsequently relatively easy. The time at which dusting can be discontinued safely will likewise depend on the amount of rust present in the dusted crop and the weather conditions which prevail. In most cases it will be advisable to continue dusting almost to the time when the crop matures.

3. The Influence of the Addition of an Oxidizing Agent to Sulphur on Rust Control.

It has been reported by Lee and Martin (Science N.S. LXVI, 1703, p. 178, Aug. 19, 1927), that the addition of oxidizing agents to sulphur greatly increased its effectiveness in controlling eye-spot of sugar cane in Hawaii. To see whether a similar result could be obtained when using sulphur for rust control, two fortieth-acre plots were dusted weekly from July 18th to September 9th, at the rate of 15 lbs. per acre with sulphur dust to which one per cent of potassium permanganate was added. These plots were compared with adjacent plots dusted at the same times and at the same rates with Kolo-dust.

Slightly better control was achieved by the addition of the potassium permanganate but the difference was not striking. Further experiments along this line are desirable.

FIELD TRIALS

A. Horse Drawn Dusters

Some preliminary experiments on field dusting with a horse-drawn duster for the control of stem rust were conducted in Manitoba in 1926. Although very little rust developed, the results obtained from these trials indicated the possibility of applying sulphur dust thoroughly and practically by means of horse-drawn dusters. This phase of the sulphur dusting investigations was continued this year using two power dusters, which were loaned for that purpose by the Niagara Sprayer Co., of Middleport, New York.

Field trials were carried out in 1927 on the Manitoba Agricultural College farm at Winnipeg and at Graysville, Manitoba, on the farm of Mr. Alex. Murray. Kolo-dust, which is produced by the Niagara Sprayer Co., was used in all the experiments.

The writers wish to express their appreciation to the Niagara Sprayer Co., for the loan of the machines and to Mr. Alex. Murray for his splendid cooperation and for his helpful advice and criticism throughout the experiments at Graysville.

Winnipeg Field Trials:

Methods

The Winnipeg field was located on the Agricultural College farm. It was a heavy clay loam which had grown corn the previous year. This field

was sown with Marquis wheat on June 10th and the initial stand and subsequent development appeared quite uniform over the entire area. The field was divided into four acre-plots separated from each other by seven-foot roadways. Dusting was done from these roadways to avoid tramping down any grain during the operation.

Dusting was begun on July 18th and was continued for eight weeks, the last application being made on September 8th. An effort was made to determine the effect of the frequency and rate of application of Kolo-dust on the control of leaf and stem rusts. One plot was dusted twice per week during the whole eight weeks at the rate of 15 lbs. per acre. Another plot received eight weekly applications at the rate of 30 lbs. per acre. Dusting was not begun on the third plot until August 15th, four weeks later than in the previous ones. It was dusted at the rate of 45 lbs. to the acre and received subsequently, three weekly applications at the same rate. The fourth plot was undusted as a check.

When dusting was begun on July 18th rust was just beginning to show up in the field. By August 15th, when the third plot was first dusted, practically all the plants in undusted plots were infected. The stem rust infection ranged from 30 to 45 per cent, while that of leaf rust was from 50 to 55 per cent. Rust developed rapidly during the early part of August and before the end of the growing season severe epidemics of both leaf and stem rust had occurred.

The Kolo-dust was applied with the same horse-drawn traction duster which was used last year. Plate 4 shows this machine in operation.

The particular combination of circumstances at Winnipeg made these trials a severe test of the efficiency of this method of rust control. Rust appeared before the wheat was headed out and developed quickly in epidemic form. Therefore the late crop had to be protected from a heavy rust attack throughout the greater part of its growing period.

Rust infection was estimated as usual on the percentage basis. Final data on leaf rust were taken on August 23rd and those on stem rust on September 13th.

Yield data were obtained by harvesting twenty rod rows from each plot. The average of these twenty samples was used in calculating the yield of each plot in bushels per acre.

Results

The results of the Winnipeg experiments are summarized in Table 3. The cost of the various treatments in relation to the results obtained therefrom is given in Table 4.

Fifteen-pounds-per-acre applications of sulphur dust applied twice per week for eight weeks resulted in a marked reduction in both leaf and stem rust and a decided improvement in yield and grade, as compared with the undusted check plot. The increase in yield was 18.7 bushels per acre and the grade was No. 4 as compared with Feed Wheat. The low grade of the dusted plot is somewhat disappointing but is due largely to factors other than rust. The weather in late August and early September was cold and

TABLE 3.—*Results of sulphur-dusting wheat with horse-drawn dusters for the control of leaf and stem rusts.*

District	Treatment	APPLICATIONS OF SULPHUR DUST: Size of plot in acres	Rate–lbs. per acre	Frequency–number per week	Total number	PERCENTAGE INFECTION: Leaf Rust Average	Stem Rust Range	Stem Rust Average	YIELD AND QUALITY RESULTS: Weight per measured bus. lbs.	Canadian Government grade	Yield per acre in bus.
Graysville, Man.	Dusted	8	25	2	6	60	15–55	35	60	3	22.6
	Undusted	1.1	0	0	0	65	65–90	85	53	5	10.3
Winnipeg, Man.	Dusted	1	15	2	15	50	20–50	40	56	4	30.2
	Dusted	1	30	1	8	60	10–50	35	58	4	29.5
	Dusted	1	45	1	4	63	45–65	55	51	6	21.8
	Undusted	1	0	0	0	70	65–95	90	44	Feed	10.8

TABLE 4.—*An analysis of the cost of various treatments in relation to the resulting increase in yield.*

District	Treatment	APPLICATION OF SULPHUR DUST: Size of plot in acres	Rate lbs. per arce	Frequency number per week	Total number	Yield in bushels per acre	Canadian Government grade	Value per bushel (a)	PER ACRE: Value of crop	Cost of sulphur used	Cost of applying sulphur (b)	Net value of crop	Increase over checks
Graysville, Man.	Dusted	8	25	2	6	22.6	3	$1.26	$28.48	$5.25	$0.75	$22.48	$11.87
	Undusted	1.1	0	0	0	10.3	5	1.03	10.61	0.00	0.00	10.61	0.00
Winnipeg, Man.	Dusted	1	15	2	15	29.5	4	1.14	33.63	7.85	3.75	22.03	13.27
	Dusted	1	30	1	8	30.2	4	1.14	34.43	8.40	2.00	24.03	15.28
	Dusted	1	45	1	4	21.8	6	0.92	20.06	6.30	1.00	12.76	4.01
	Undusted	1	0	0	0	10.8	Feed	0.81	8.76	0.00	0.00	8.76	0.00

(a) Winnipeg cash prices, Oct. 20th, 1927.
(b) The depreciation of dusting machine is not included.

wet and altogether unsuitable for finishing off this late piece of wheat. Frost caused considerable shrinking and the wet weather spoiled the colour of the sample.

The plot dusted weekly for eight weeks at the rate of 30 lbs. per acre yielded as well as the plot dusted twice as often at 15 lbs. per acre. Even the plot which received only four weekly applications at the rate of 45 lbs per acre yielded 11 bushels per acre more than the check. In this instance however, there was little improvement over the check in the quality of the threshed sample.

From the standpoint of net returns the weekly applications at 30 lbs. per acre proved the most profitable, the net increase in value per acre due to dusting being $15.28. This result seems to indicate that heavy enough applications of sulphur dust can be applied to ensure the effective control of stem rust, even under conditions unusually favorable to its development, without sacrificing the practicability of the treatment.

Graysville Field Trials:

Methods

This trial was carried out on the farm of Mr. Alex. Murray, who sowed a nine-acre field with Marquis specially for the experiment. The field was a half-mile long by nine and a half rods wide. Across one end of the field an area of slightly less than an acre was left undusted as a check.

The remaining eight acres were dusted six times at the rate of 25 lbs. to the acre. The first dusting was done on July 21st, at which time only about 60 per cent of the wheat was headed and leaf and stem rust were easily found. By July 29th about 50 per cent of the plants were lightly infected with stem rust. Dust was applied twice per week from July 21st to August 13th. During this period conditions were most favorable for rust and a severe epidemic of both leaf and stem rust developed.

The dust was applied by a Niagara "Aero Duster" specially modified for cereal dusting. This duster was mounted on a platform on two high wheels, and the outfit was equipped with a 5 H.P. New Way engine. The dust was discharged through a five-inch blower pipe which oscillated from side to side and distributed the dust, as the machine was drawn through the crop by a team of horses. Ordinarily this machine dusted effectively a swath thirty feet wide and, if the air were calm, a forty-foot strip could be covered satisfactorily.

The percentage infection in the dusted and undusted area was determined on August 25th. Field data were obtained through the courtesy of Mr. Murray, who harvested and threshed separately the dusted and undusted parts of the field. The threshed samples were graded by the local elevator operator.

Results

The results of this experiment are summarized in Table 3. The cost of the treatment in relation to the results obtained is given in Table 4. The average infection of stem rust in the dusted area was 35 per cent as compared with 85 per cent in the undusted area. Dusting increased the yield

by 12 bushels per acre and the grade from No. 5 to 3 Northern. This represented a net increase in crop value per acre of $11.87, due to the control of rust through dusting with sulphur. The cost data are based on current labor costs and the time which Mr. Murray spent in making the six applications. The result would have been even better had the crop ripened more quickly or if another application of dust had been applied. The last dusting on August 13th was followed on August 14th by a heavy rain. Unfortunately the supply of dust was exhausted by this time and further applications were impossible. The crop was not cut until September 6th, and between August 10th and September 6th the rust developed considerably.

Discussion

The results obtained in the control of wheat stem rust through the application of sulphur dust with horse-drawn dusters are a convincing demonstration of the practical possibilities of this method of rust control. The Graysville results of a trial which was carried out by a farmer on his own farm are especially convincing. It seems certain that this method of rust control will be widely introduced and extensively used as soon as a thoroughly satisfactory cereal duster is developed.

The duster used this year at Graysville, while it is the best that is available and is a satisfactory machine in many respects, is not well suited to large-scale cereal dusting. The distribution was not sufficiently uniform and the swath effectively dusted was too narrow.

Field results this year indicated that the crop has to be thoroughly covered with sulphur each time it is dusted, if rust is to be satisfactorily controlled. This was evident both at Graysville and at Winnipeg. At Winnipeg, where the acre-plots were dusted from roadways, which went all around each plot, the central part of one plot was a little beyond reach of the duster. This central strip rusted heavily, although on the rest of the plot rust was satisfactorily controlled. At Graysville the first swath was laid down thirty feet into the field from the outside edge. This left a strip about twelve feet wide on the outside which was beyond the effective reach of the machine. This strip rusted just as heavily as the completely undusted check plot. (See Plate 5).

The ideal duster, therefore, must dust uniformly a swath at least 50 feet wide and must be so built that a minimum of mechanical injury is done to the standing crop during dusting operations. A tractor duster with narrow high wheels, and equipped with a high-power duster attachment, appears most desirable, if it can be produced at a reasonable cost. With the effectiveness of the treatment no longer in doubt, the solution of the mechanical difficulties incidental to the development of a satisfactory duster for cereal dusting should be easily surmounted.

B. Aeroplane Dusting

The success which has attended aeroplane dusting for boll weevil control sugested aeroplane dusting as a feasible method of using sulphur for controlling rust over large areas.

Accordingly aeroplane sulphur dusting was undertaken this year in Manitoba in a series of cooperative experiments between the Royal Canadian Air Force and the Dominion Rust Research Laboratory. The Air Force supplied for these experiments a new Huff-Daland dusting plane, similar to those recommended in the cotton dusting work (*). This plane was under the very able direction of Flying Officer T. M. Shields. Areas of approximately 250 acres each were chosen for dusting at each of the following localities—Graysville, Portage and Morden.

Experimental Methods

In Manitoba, due to the extremely wet and late Spring of 1927, the acreage of common spring wheat was greatly reduced. The task of locating large fields of late-maturing, common wheats suitable for aeroplane dusting experiments, and in close proximity to a satisfactory landing base was a difficult one. It was necessary to divide each district into three or four dusting areas. In this way it was possible to select fields of Marquis wheat for dusting purposes and to have in close proximity to them fields of the same variety, growing under similar conditions which could be left undusted for controls. In each dusting area the check field was either a portion of the field under experiment which was left undusted, or an adjoining field of the same variety, very similar in stage of maturity and type of growth, and subject to the same environment.

All of the dusting was done with the same plane, the Huff-Daland duster mentioned above. This machine had a hopper capacity of 600 lbs. but the agitator did not work properly if more than 400 lbs. were used at a time. The dust was released at heights of 15 to 25 feet over the crop, depending on the atmospheric conditions. The average speed of the plane while dusting, was around 100 miles per hour. Evening was found to be the most satisfactory time for dusting, because as a rule there was no wind then and the dust settled uniformily and with very little drifting. Very unsatisfactory results were obtained if a wind of ten miles per hour or over were moving. The actual time of releasing the dust was the shortest part of the operation, most of the time being consumed turning at the ends of fields and coming down for new loads.

Field results on dusted and undusted areas were taken from the yield of 20 rod rows chosen at random throughout the field. The yields which were actually obtained from field threshing were also secured.

All threshed samples were graded for quality according to the Dominion Government Grades.

Experimental Results

Morden District

Six fields of Marquis wheat comprising an area of 220 acres were dusted in this district. The first application was made on July 13th, at which time a light trace of stem rust was general and leaf rust was well established.

*Post, G. B. Boll Weevil Control by Airplane. Georgia State College of Agr. Bull. 301. 1924.

Area 1: In this area two fields, one of 20 acres and the other of 70 acres were dusted: The first of these received five applications six days apart, while the second was dusted four times at weekly intervals. On the 20-acre field the rate of application was approximately 15 lbs. of sulphur per acre, and on the 70-acre one, about 12 lbs. per acre were used. An eleven-acre strip of the 70-acre field was used as a check in the one case, while an adjoining 30-acre field was used for comparison with the 20-acre field.

Neither the yield nor the grade of the 70-acre field were influenced by dusting, although rust was slightly less severe than in the check. The 20-acre field yielded 8 bushels per acre more than its check, weighed 4½ lbs. per bushel more and graded 4 as compared with 5 for the check.

Area 2: This area was made up of three adjoining fields of 40, 40 and 30 acres. While this gave a continuous stretch of over a mile, it was not altogether satisfactory since a road allowance with telegraph poles, and scrub growing along a fence made some difficulty in finishing the ends of two of the fields. These fields were dusted four times at weekly intervals and at the rate of 12 lbs. of sulphur to the acre. One field was given one additional application.

Area 3: This consisted of a late 20-acre piece of Marquis, which was dusted only twice, relatively late in the season. The first application was made on July 29th and the second on August 9th and approximately 20 lbs. per acre were applied each time. Four acres of the same field were so located that they could be left undusted as a check.

The two dustings carried out here had very little influence on the final rust infection or on the yield, though it may have slightly influenced the grade of the sample.

Conclusion

The results for this district are summarized in Table 5. They emphasize the difficulty of obtaining reliable check plots for such experiments. It is practically impossible to leave a part of a field undusted, except where the acreage is large and continuous. With small acreages a certain amount of sulphur inevitably drifts over the check and it is impossible to judge the feed of the sulphur within a few feet when travelling at 100 miles per hour. An adjoining field may be altogether unsuitable for a check. To obtain a further check on the results, therefore, an average yield for the whole district was estimated from a survey at threshing time and from information obtained from local elevator operators. This average was between eleven and twelve bushels per acre and practically none of the wheat from the district graded above No. 3 Northern. As compared with this average, all of the dusted fields showed considerable improvement both in yield and grade.

Taken as a whole, however, the results in the Morden district were disappointing. This was due in part to the unfortunate weather conditions that prevailed when some of the applications were made and to heavy showers following closely after applications and thus cutting down their effectiveness.

TABLE 5.—*Results of dusting Marquis wheat with sulphur by aeroplane for the control of stem rust at Morden, Man.*

Area	Treatment	Acres	Dusting Period, July 13th–August 9th			Percentage infection of stem rust		Yield and Quality Results			
			Rate of application lbs. per ac.	Interval between applications in days	Total number of applications	Range	Average	Weight per measured bushel lbs.	Canadian Government grade	Yield per acre in bus.	Field results(*) yield per acre in bus.
1	Dusted	20	15	6	5	30–75	60	60	4	20.6	18
	Undusted	30	0	0	0	65–85	80	55.5	5	9.7	10
	Dusted	70	12	7	4	60–85	75	58	4	18.8	17
	Undusted	11	0	0	0	60–95	85	56	4	18.1	17
2	Dusted	40	12	7	5	20–85	55	61	3	17.1	17
	Dusted	40	12	7	4	10–65	45	63	3	35.6	20
	Dusted	30	12	7	4	25–75	55	61	3	28.8	15
	Undusted	14	0	0	0	40–80	60	60	3	26.3	17
3	Dusted	20	20	10	2	20–80	45	59	2	19.7	19
	Undusted	4	0	0	0	30–85	45	56	3	16.2	18

(*) Yields obtained from actual field threshing operations.

In addition, the rate of application was not heavy enough. While 10 to 15 lbs. of sulphur per acre seemed to give satisfactory coverage, it is evident that from 20 to 30 lbs. per acre would be necessary to secure results in a season like the past one.

Portage District

Approximately 245 acres in four different fields were dusted in this district. One of these was a 110-acre field of Quality. This received four, 12-lb.-per-acre applications, seven days apart. Rust was well established in the field when dusting was commenced and field evidence suggested strongly that rust development was satisfactorily checked. The part of this field which was left for a check, however, was thoroughly dusted by mistake and no satisfactory check was available. A small 10-acre field of Quality situated about a mile from the field yielded about the same as the dusted field, but no conclusion can fairly be drawn from this.

A 45-acre piece of Marquis was dusted only twice, two weeks elapsing between dustings. The rate of application was 15 lbs. to the acre. A 20-acre piece was dusted three times with a seven-day interval between applications at the same rate. These were dusted for the first time on July 18th, at which time only about 40 per cent of the heads had broken through the boot. Following the final dusting, which took place on August 9th, weather conditions were favorable to rust development and were quite unsuitable for finishing off the slowly maturing crop. Therefore, while the rust seemed to be held in check satisfactorily while the dusting was continued, subsequently it developed sufficiently to wipe out the differences between the dusted and undusted areas.

Four applications were made also on a very late 70-acre field of Marquis which was just beginning to head on July 18th when it was first dusted. The last application was made on August 9th and four weeks elapsed subsequently before the field was cut. By that time rust infection was just as heavy as on the check.

The results for the district are summarized in Table 6. That they are negative is not surprising under the circumstances. The crop was late, dusting was stopped before the crop was out of danger of attack, heavy rains followed within a day after two of the applications and a third was done during a wind. These results indicate quite clearly that dusting must be continued until the crop begins to mature if positive results are to be secured. They further indicate that heavier applications are essential.

Graysville District

Approximately 190 acres of wheat were dusted in this district. Weather conditions were ideal each time dusting was done and the lay-out of the fields was the most suitable for aeroplane dusting of any of the areas worked with.

Area 1: Two fields of Marquis, 75 and 30 acres in extent, were dusted and 20 acres left undusted for a check. Four 15 lbs.-per-acre applications were applied at seven day intervals.

TABLE 6.—*Results of dusting wheat with sulphur by aeroplane for the control of stem rust at Portage la Prairie, Man.*

Area	Variety	Treatment	Acres	Dusting Period, July 18th–Aug. 9th Rate of application lbs. per ac.	Interval between applications Days	Total number of applications	The Percentage infection of stem rust Range	Average	Weight per measured bushel in lbs.	Canadian Government grade	Yield per acre in bushels	Field results* yield per acre in bushels
1	Marquis	Dusted	45	15	14	2	60–90	75	58	3 N	21.1	23
		Undusted	40	0	0	0	60–90	80	58	3 N	20.8	20
2	Quality	Dusted	110	12	7	4	25–80	60	59	3 N	34.0	19
		Undusted	10	0	0	0	30–90	60	59	3 N	32.6	19
3	Marquis	Dusted	20	15	7	3	50–80	65	57	4	22.1	14
		Undusted	30	0	0	0	60–85	75	55	4	14.5	11
4	Marquis	Dusted	70	15	7	4	30–95	85	54	5	14.3	19
		Undusted	12	0	0	0	70–95	85	54	5	15.2	19

(*) Yields obtained from actual field threshing operations.

TABLE 7.—*Results of dusting wheat with sulphur by aeroplane for the control of stem rust at Graysville, Man.*

Area	Variety	Treatment	Acres	Dusting Period July 14th—Aug. 3rd Rate of application lbs. per acre	Interval between applications Days	Total number of applications	The Percentage infection of stem rust Range	Average	Weight per measured bushel lbs.	Canadian Government grade	Yield per acre in bushels	Field results* yield per acre in bushels
1	Marquis	Dusted	75	15	7	4	20–70	45	61	2 N	33.8	22
		Dusted	30	15	7	4	20–65	35	63	1 N	40.7	28
		Undusted	20	0	0	0	40–95	75	59	5	20.8	13
2	Marquis	Dusted	14	20	7	3	40–80	65	60.5	3 N	29.2	16
		Undusted	30	0	0	0	45–95	85	54	6	18.2	12
3	Ruby	Dusted	37	20	7	2	30–75	50	62	2 N	29.0	23
		Undusted	18	0	0	0	40–80	65	60	3 N	19.2	17

(*) Yields obtained from actual field threshing operations.

The control in this instance was thoroughly satisfactory. The rust infection was 35 and 45 per cent in the dusted fields as compared with 75 in the check. The yields were 22 and 28 bushels of No. 2 and No. 1 Northern wheat as compared with 13 bushels per acre of No. 5 in the check. If we look at the financial side of this particular instance, we find in one case a difference in yield of 15 bushels per acre and an improvement in grade from No. 5 to No. 1 Northern through controlling rust. Figuring this out at Winnipeg prices quoted October 20th, 1927, this represents a $42.00 per acre increase in value through dusting. About 60 lbs. of sulphur per acre was used, which would cost not more than $2.50. This leaves surely an ample margin for any reasonable cost of application which is effective.

Area 2: A 14-acre piece of Marquis was dusted three times at weekly intervals at the rate of 20 lbs. per acre and was compared with an adjoining 30 acres for a check.

The control achieved in this instance was not quite so satisfactory as in Area 1, so far as yield was concerned. The dusted field yielded 16 bushels per acre as compared with 12 for the check and the grade was No. 3 Northern as compared with No. 6.

Area 3: A 37-acre piece of Ruby was dusted twice, with a 7-day interval between the applications and the first one on July 15th. One week after the second application it was obvious that the field was ripening well ahead of the rust and that further applications were unnecessary.

A nearby piece of Ruby comparable in maturity and stand was used as a check. The dusted field carried an average rust infection of 50 per cent and yielded 23 bushels per acre of No. 2 Northern wheat. The check was somewhat more heavily rusted and yielded 17 bushels per acre of No. 3 Northern.

The results from the Graysville district are summarized in Table 7. Taken as a whole they are an interesting demonstration of the possibilities of aeroplane dusting and a sufficient reason for continuing the experiments.

Discussion

The results of these experiments can be evaluated accurately only if they are considered in relation to the season in which they were accumulated. This was truly unusual in several significant respects. In the first place, a very heavy rust epidemic, comparable only with those of 1916 and 1923, occurred and made the test as severe as possible from that standpoint. Also, the rainfall during the months of May, June, July and August was greatly in excess of the ten year average for those months and heavy dashing rains, usually so uncommon in Manitoba, were frequent. The crop on the whole was very much later than usual and there was the greatest variation in maturity in any given district. All of these circumstances were conducive to heavy rust infection and at the same time mitigated against the success of a dust treatment. The test must therefore be considered unusually exacting and severe. There is also the further consideration that the season was definitely unfavorable to finishing off the wheat crop, the yields in the

absence of rust were disappointing and hence the control of rust in many cases did not result in the striking gain in yield which would ordinarily have been expected.

Considering the season and the fact that this was the first season's work on an entirely new venture, the results were distinctly encouraging. The Graysville results were outstanding, those at Morden were not convincing, while the Portage ones were disappointing. In every case, with the one possible exception of the very late field at Portage, however, the dusted fields were significantly better in yield and weight per bushel than the general average of the immediate district in which they were located. The variability in the results emphasizes the importance of four factors namely, the time of application, thoroughness of application, the rate of application, and the weather conditions following the application. Judging from the Graysville results, if dusting is started in advance of the rust attack, if relatively heavy applications are used and if no heavy dashing rains occur between dustings, aeroplane sulphur-dusting can be counted on to control rust and to increase the yield greatly. From the negative results at Portage, it is evident that, if it is to be effective, dusting must be continued until the crop begins to mature and the effectiveness of an application is at an end as soon as a heavy rain occurs. From all of the results it is evident that a heavier application than was used is desirable for aeroplane dusting.

Perhaps the most satisfying feature of the year's results was the convincing demonstration that the aeroplane is so well suited to this work. The rapidity and thoroughness with which large areas can be covered leave nothing to be desired. Since there is as much flying involved in manouvering at the ends of the fields as in the actual dusting, the method is suited essentially to large continuous acreages. It seems probable that the cost of application would be prohibitive on small acreages and, at the speed the plane is travelling, it is next to impossible in such cases, to govern the flow of dust so as to avoid waste and at the same time ensure proper coverage. Since repeated rust losses have forced a considerable degree of diversification in agriculture in Manitoba, one is apt to find the wheat acreage broken up into blocks of 20 to 50 acres and this fact may limit the usefulness of aeroplane dusting in certain districts.

The cost of applying the sulphur has not been computed for this season's work because it would have been of very little significance in relation to the economic possibilities of the method. It seems certain that a three year dusting programme at least will be necessary to give this method a fair trial and determine its practicability.

The results obtained already justify the continuance of this work. Profiting by the experience obtained this year, another season's experiments should go a long way toward indicating both the limits of effectiveness and the practical possibilities of aeroplane dusting.

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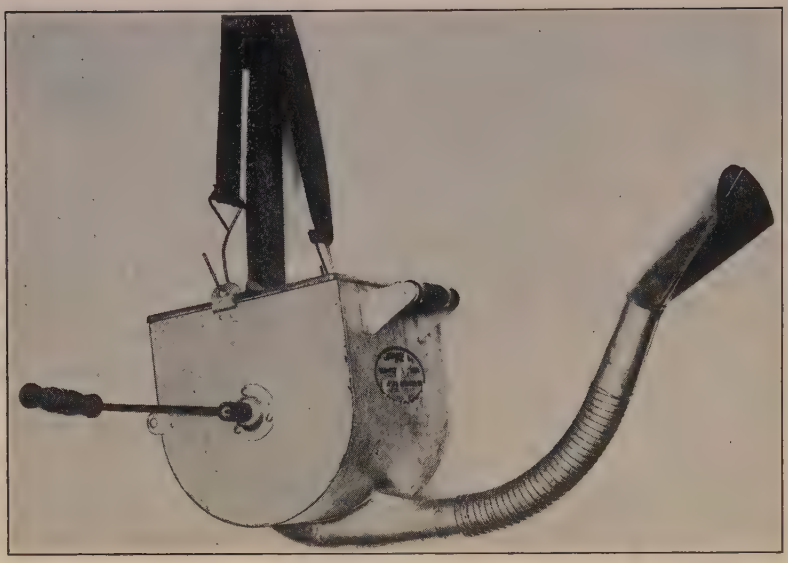

Plate I. The type of hand-duster (Niagara Blower Dust Gun No. 42) used in the small plot sulphur dusting experiments. The duster is suspended by cross straps from the shoulders of the operator. The fan is rotated by means of a crank.

Plate II. The effectiveness of sulphur dust in controlling leaf rust of wheat—*Puccinia triticina*, under conditions of a natural epidemic in 1927.

Above—Leaf from plot of Marquis wheat dusted tri-weekly at the rate of 30 lbs. of sulphur per acre.

Below—Leaf from plot of Marquis wheat grown under similar conditions but which remained undusted.

Plate III. The effect of controlling rust by sulphur dusting on the size and plumpness of heads and kernels of Marquis wheat plants grown in 1927.

A—Heads and kernels of Marquis wheat plants dusted tri-weekly at the rate of 30 lbs. per acre.

B—Heads and kernels of Marquis wheat plants grown under the same conditions but which were not dusted.

Plate IV. Horse-drawn traction dusting machine (Niagara Traction Crop Duster C-26-P) in operation. A cloud of dust is discharged through a flexible delivery tube, 5 inches in diameter.

Plate V. Dusted and undusted sections of a field of Marquis wheat at Graysville, Manitoba. Sept. 13th, 1927.

Left—Section of a field dusted semi-weekly for a period of three weeks at the rate of 25 lbs of sulphur per acre. Note the erectness of the dusted plants, and also the size and plumpness of heads.

Right—A strip of the same field not dusted. Note the small unfilled heads and the characteristic breaking of the heavily rusted straw. A yielded 12 bushels per acre more than B and the grades were No. 3 Northern and No. 5 respectively.

Plate VI. The Huff-Daland plane used for sulphur dusting operations. The dust hopper is immediately in front of the cockpit from which the machine is controlled.

Plate VII. Huff-Daland plane. The distributor through which the dust is discharged is shown projecting below fuselage. Dust delivery is controlled by the pilot. The small propeller turns the agitator inside of the hopper.

Plate VIII. Loading the dusting plane with sulphur. Hopper capacity 600 lbs.

Plate IX.—Dusting plane approaching the camera, showing the downward trend of the dust cloud.

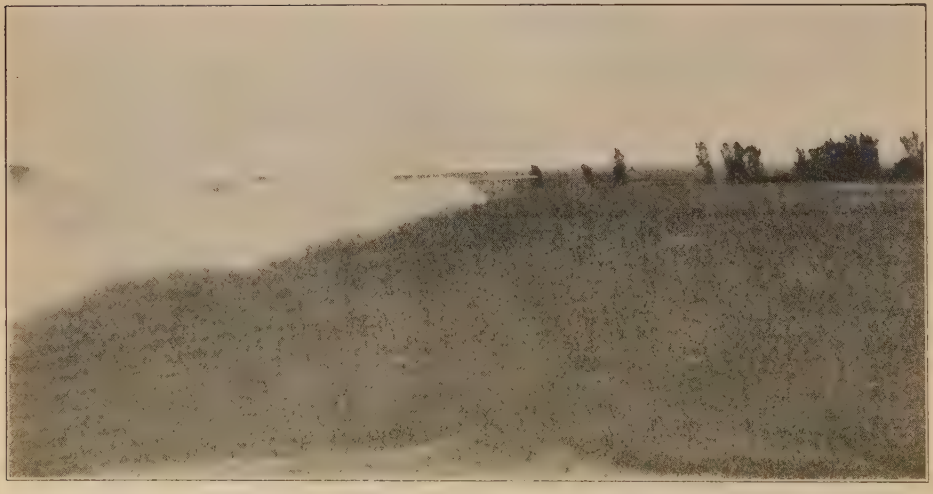

Plate X. Dusting plane in operation showing the spiral travel of dust caused by rotational flow of air from the propeller. The plane is flying about 20 feet above the wheat plants.

THE ELEMENT OF RISK IN CEREAL PRODUCTION.

W. Burton Hurd

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Farming is essentially a business enterprise and each year the grain grower has to face the practical business problem as to what crops it will pay best to grow and just how he should divide his acreage between the various cereals. Each district, and indeed each farm, presents a special problem. The successful farmer has to take into consideration many factors of a purely local nature. In each district there are peculiarities of weather, soil composition and topography. These are matters of first importance in making plans for putting in a crop. Yet, just as the astute business man looks to the general experience of the trade for the broad lines of business policy, so the progressive farmer of to-day tends to pay more and more attention to the underlying conditions of success as revealed by the experience of the farming community at large. This is especially true of the grain grower in western Canada, and the specific purpose of this article is to suggest certain underlying considerations, following from a statistical examination of the results of twenty years of grain growing in the three Prairie Provinces, which should be taken into the reckoning in distributing available acreage between the three principal cereals.

The first problem facing the grain grower is the chance of getting a crop. Are the risks greater or less in growing wheat than oats, or in growing oats than barley? To permit any generalization in answer to such a question, the yields over a period of years must be examined, and these are available only by provinces. Further, conclusions to be at all reliable, must be based on the experience of very considerable areas so that the chance of purely local eccentricities of weather, etc., may be eliminated. The provincial data are thus admirably suited for the purpose in hand. Accordingly, an analysis was made of the yields per acre of the three principal cereals grown in Western Canada for the 21 year period, 1905 to 1925 inclusive.

It was found that the average yield of wheat in the three provinces was gradually declining, so fluctuations in yields were taken above and below the expected yield for each year, which was computed on the basis of the general downward trend. The fluctuations thus found were combined by suitable mathematical methods into a percentage coefficient which measures the tendency of the yield of wheat to fluctuate. The same procedure was followed with oats and barley and the results for each of the three Prairie Provinces appear below:

Percentage fluctuations in yields per acre

Province	Spring Wheat	Oats	Barley
	%	%	%
Manitoba	21.5	17.1	19.3
Saskatchewan	27.0	24.1	21.6
Alberta	31.0	23.8	20.7

It is at once apparent that in each province, the fluctuations in wheat yields are more marked than those in either oats or barley. On the basis of the cereal yields for the 21 years under examination, the chances of an exceptionally good crop or a failure for wheat as against oats and barley respectively, on the average farms in the three western provinces, are as follows:

Alberta: Spring wheat 30 per cent greater than oats; 50 per cent greater than barley.

Saskatchewan: Spring wheat 12 per cent greater than oats; 25 per cent greater than barley.

Manitoba: Spring wheat 26 per cent greater than oats; 11 per cent greater than barley.

Thus, on the average farm in Western Canada, while the chances of a 'bumper' wheat crop are from 12 per cent to 30 per cent greater than for an exceptional crop of oats and 11 per cent to 50 per cent greater than for an unusually heavy yield of barley, the chances of a comparative failure in the wheat crop are also proportionately greater. The average farmer is therefore taking a considerably greater risk on the score of yield, in raising wheat than in growing either of the other two cereals. The wheat grower is less sure of a crop but when he gets a good one, the yield is more likely to be exceptional. This holds true for each of the three western provinces.

It is interesting to note in passing, that the risks run by the average wheat farmer are somewhat greater in Alberta than in Saskatchewan and considerably greater than in Manitoba. To be specific, the risks in raising wheat in Alberta are, on the average, 44 per cent greater than in Manitoba, and in Saskatchewan approximately 25 per cent greater. Similar differences appear in the reliability of yields of the two other cereals as between the two western provinces and Manitoba, but they are much less marked.

In pointing out these differences between the results of grain growing in the three provinces, reference is made only to reliability of yield. The reader, however, may be interested in associating with the above findings, data on the general level of provincial yields. In the table appearing below, it is seen that Alberta has the advantage over Saskatchewan for all three crops, and between the years 1905 and 1917 Alberta had a higher average wheat yield per acre than the province of Manitoba. During the last eight years of the period, however, the average output of wheat per acre in Manitoba was slightly greater than that in Alberta, while in the 21 year period as a whole, as well as in the latter part of it, the general level of yields of barley and oats in Manitoba has been the highest in the West.

Average yield in bushels per acre

	1905-1925			*1918-1925*		
Province	Wheat	Oats	Barley	Wheat	Oats	Barley
Manitoba	16.7	36.1	26.5	15.3	32.8	24.3
Saskatchewan	16.5	34.2	24.5	14.2	29.9	23.0
Alberta	18.6	35.0	25.6	15.0	31.4	24.3

Many factors are involved in explaining the differences in average yields between the various sections of the country. The variations in the speculative character of the crops in the three provinces are probably attributable, for the most part, to differences in the pest and climatic hazards. The cultivation of wheat in large sections of Alberta which are peculiarly subject to drought, accounts in no small measure for the exceptionally wide fluctuations in the yields in that province. However that may be, from the point of view of yield, the risk in raising wheat in all three provinces is greater than that run in growing either of the other two cereals, and the hazards in growing wheat are greater on the average farm in the province, as we pass westward from Manitoba to Alberta.

Fluctuations in Prices.

So far, attention has been fixed on the output in bushels per acre. The grain grower, however, is concerned not only with the actual size of his crop but he must also take into consideration the price he is likely to get for it. The question arises as to how far the importance of the differences in the reliability of yields is discounted or re-inforced by movements in the annual market quotations.

The average yearly cash prices per bushel at Winnipeg, of No. 1 Northern Wheat, No. 2 C. W. Oats and No. 3 C. W. Barley respectively, were taken for the crop years 1905-6 to 1925-6, as published by the Dominion Bureau of Statistics. The quotations for the abnormal period of the war were omitted. The average price for the remaining years was calculated and fluctuations above and below that average were expressed for each cereal, in a percentage coefficient which measures the tendency of the prices to fluctuate. The results follow:

	Price Fluctuations
Wheat	30.8%
Oats	19.0%
Barley	23.1%

The fluctuation of the yearly price of wheat is seen to be approximately 62 per cent greater than for oats and 33 per cent greater than for barley.

Now the point of interest to the producer is how far the fluctuations in cereal prices tend to offset fluctuations in yields. At first glance it might appear that when yields are low prices tend to go up with marked consistency and offset the losses which otherwise would occur. One is reminded, however, that the market for cereals, especially for wheat, is an international one. Making allowance for transportation costs, etc., the price tends to be determined by the balance between the world's demand and the world's supply in a given season. With the grain growing areas of the world so widely distributed, it is not to be expected that world prices would be especially sensitive to fluctuations in yields in a given country, and much less so to crop conditions in a given province or district.

The changing trend of cereal prices in the past few years, makes it peculiarly difficult to measure the relationship between yields and prices in western Canada with any degree of mathematical accuracy. Until some further work is done on the subject, no categorical statement can be made.

However, if the prices for the period be compared with the yields per acre in each of the provinces, by the crude method of plotting the data, it is found that price fluctuations show a marked tendency to offset fluctuations in yields in between 50 and 60 per cent of the cases for barley, 60 and 70 per cent for wheat and in slightly over 70 per cent of the cases for oats.† No great accuracy is claimed for these figures, and they may require revision in the light of a more careful analysis at some future date, but the inference that fluctuations in the price of oats reflect variations in provincial acreage yields much more closely than in the case of wheat, and that wheat prices in turn are more sensitive to fluctuations in yields than are the prices of barley, is confirmed by an examination of the average money return per acre for the three cereals as shown by the Dominion Bureau of Statistics' returns from Western Canada for the past five years.

During this period, the average variation in gross returns per acre planted in wheat was approximately 40 per cent greater than for the acre planted in oats. It is recalled that the fluctuations in the yields of wheat were only from 12 per cent to 26 per cent greater than in the yields of oats in the three western provinces. The obvious inference is that oats is a much steadier crop than wheat, both on the score of certainty of yield and on the ground of the compensating influence of price fluctuation. On the other hand, the data in respect to barley production and prices in the three western provinces, reveal a very different situation. As in the case of the other cereals, the experience of the past five years again confirms the findings resulting from the crude price analysis presented above. The price which the average western farmer received for his acre planted in barley fluctuated approximately 17 per cent more than that for his acre planted in wheat. This figure is probably higher than would normally be expected, because of the influence of the unusually high barley prices in 1924. When using annual data for so short a period as five years the effect of an extreme item on the final result is unduly great. It seems clear, however, that while fluctuations in yield are much smaller for barley than wheat, the rise and fall in barley prices cannot be counted upon to offset variations in yield with anything like so great consistency as in the case of the other two cereals.

Thus, as far as certainty of gross money return per acre is concerned, oats is much more reliable than either wheat or barley as a money crop, and if there is anything to choose between the speculative nature of wheat production and the growing of barley for market, it would appear that under existing conditions in western Canada, the producing of wheat has involved slightly less risk.

† Even in the years when prices tended to move inversely with yields, the extent of the compensating influence, on the average, was not very great for any of the cereals. Were the magnitude of price movements taken into consideration, as well as their direction, over a considerable period, it is quite possible that the net effect of price fluctuations would be to increase rather than reduce the risk in all three cases. This, however, would not invalidate the conclusions reached. They refer to the *relative* influence of price movements on the speculative nature of the three cereal crops. If the net effect of price fluctuations is to increase the hazard, it increases it less for oats than for wheat. If the net effect is to reduce the hazard, it reduces it more for oats than for wheat. In either case, the influence of price fluctuations is to make the return on oats as compared with wheat, relatively more stable than the data on yields alone would indicate.

Which Crop Pays Best?

One further question arises, namely, which cereal pays best in the long run? That is exceedingly difficult to demonstrate from data for the western provinces. In the first place, the average cost of raising the different cereals has not been computed for a sufficient number of representative years to warrant a reliable generalization for the west. Further, large proportions of the coarse grains are used locally for feeding, and the amount that the farmer ultimately realizes on the part of his oats and barley crop consumed on the farm, is exceedingly difficult to compute. There is no doubt, however, that, on the average, wheat pays better as a money crop. The cost of carriage of the coarse grains is so great, relative to their value, and western Canada so far removed from the market, that oats and barley are at a considerable disadvantage. This disadvantage in respect to transportation is removed when the coarse grains are shipped in the form of meat and dairy products.

In conclusion, then, the farmer in western Canada who raises wheat, sacrifices security to larger profits. When he raises barley for the market, he appears to gain in respect to certainty of yield, but to lose both on the count of average price level and uncertainty as to price fluctuations from year to year. In oat production, there is greater stability of yield and greater sensitiveness in the matter of price fluctuation, though in the long run smaller profits than in raising wheat when both are grown as money crops. Sound business practice for the grain grower without considerable financial backing would therefore be to apportion his money crops so that he runs no greater risk than his financial position warrants, yet not to sacrifice his chances of good profits unduly.

Further, it would appear that the farmer who wishes to consolidate his position and reduce the uncertainty of his income, should look forward more and more to raising and shipping coarse grains in the form of meat and dairy products, on which the costs of carriage are relatively light. This is conditioned, of course, by the possibility of securing stabilized and favourable markets for these secondary products. The general gain in yields, which normally results from such a policy, is so familiar that further comment is unnecessary.

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A DWARFING CHARACTER IN SWEET CLOVER.*

A. T. Elders†

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There are few, if any, records of the breeding behaviour of hereditary characters in sweet clover. In 1924 Kirk *(1)* found and described ten different aberrant types of sweet clover and suggested that they were the result of natural crossing between alfalfa and sweet clover. In 1926 Kirk *(2)* further reported on some of these plants, but no definite Mendelian ratios were given, nor was there any suggestion of their genotypic make-up. In 1924, apparently the same summer that Kirk found his aberrant types, S. J. Sigfusson of the Dominion Experimental Farm, Brandon, found a dwarf plant of sweet clover that hitherto has not been reported.

Origin.

The original mother plant was found growing at the corner of one of the plots of a sweet clover "Date and Depth of Seeding" experiment This experiment was made on Range 7., Field C., of the Brandon Farm. According to the records the variety of sweet clover used in this test was ordinary Common White sweet clover. No further history of the seed is known except that these cultural sweet clover experiments were grown from commercial seed bought from the A. E McKenzie Seed Co. of Brandon.

Description.

The dwarf plant is a true biennial. It produces a low bushy growth during the first year in contrast to the tall spreading somewhat coarse growth of normal sweet clover (Figure 2). The second year's growth consists of thirty to forty fine stems growing from a branching crown to a height of about thirty inches. The plant flowers normally and produces seed freely.

As far as can be determined this dwarf in sweet clover must have arisen as a sport. The segregation received in the progeny of the plant points toward it being the result of a mutation of a single factor difference.

Inheritance.

On the basis that the dwarf character is dependent on a simple recessive factor only dwarf plants would result if the mother plant were naturally self-fertilized. Should there be natural crossing, however, tall plants would be found in the progeny to whatever extent natural crossing takes place. In 1925 about four hundred plants were grown from seed of the original mother plant. Eight per cent of this population were normal tall and ninety-two per cent were dwarf plants.

These results would indicate that there had been eight per cent natural crossing on the original mother plant. The tall plants resulting from the union of gametes containing D and d would be heterozygous. Upon self-

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†The writer wishes to acknowledge the work of R. A. Derick, M.S., who directed the propagation and growing of the plants used in this study.

Fig. 1.

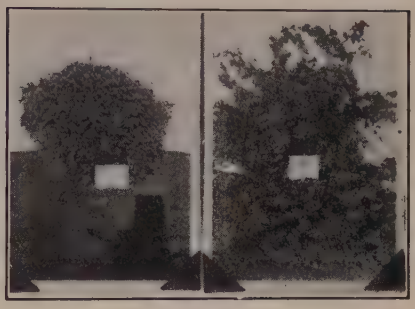

Fig. 2.

FIGURE 1. Original dwarf sweet clover plant. FIGURE 2. Dwarf (left) and Annual Sweet Clover (right).

ing these tall plants should give a three to one ratio of tall to dwarf. The dwarf plants would be homozygous for the dwarf habit of growth and when selfed would produce only dwarf plants. Consequently both tall and dwarf plants were selfed in 1926, the dwarfs by placing cotton tents over the entire plant, while the talls were selfed by enclosing some of the racemes in vegetable parchment paper bags before the buds began to open.

Progeny from Selfed Tall Plants.

Seven tall plants were selfed in 1926 and families raised from each plant as in Table 1. A three to one ratio of tall to dwarf was obtained. According to the P. E. this ratio is a very good fit to the theoretical ratio. One would expect a ratio as good or better than the one received seventy-five times out of one hundred.

TABLE 1.—*Progeny from tall selfed plants.*

Number of Mother Plant	Treatment	Number of tall plants	Number of dwarf plants
Sc 6–IT	Selfed	15	6
Sc 7–IT	Selfed	19	4
Sc 11–TT	Selfed	14	9
Sc 12–IT	Selfed	11	6
Sc 14–IT	Selfed	2	4
Sc 16–IT	Selfed	31	5
Sc 36–IT	Selfed	18	11
Ratio received	110	talls to 45	dwarf
Theoretical ratio	116.25	talls to 38.75	dwarf

PROGENY OF OPEN FERTILIZED AND SELFED DWARF PLANTS.

In 1927 twenty-two families were grown, each from a single plant. Ten of these families were from open fertilized mother plants and twelve from selfed mother plants. Notes were taken on the breeding behaviour of these families with regard to tall and dwarf habit of growth. These notes are given in Table 2.

It will be noted that the families from selfed dwarf mother plants bred true for the dwarf character with the exception of two families, each of which contained a single tall plant. It is assumed that these two plants were the result of natural crossing as certain cages were opened frequently to allow inspection by visitors.

The open fertilized families in every case but one contained a certain number of tall plants. In the ten families grown there were one hundred and thirty-six dwarf plants and thirty-one or 22.96 per cent tall plants. This would indicate further that this particular dwarf sweet clover crosses naturally with normal tall white sweet clover.

TABLE 2. *Families of open and self fertilized dwarf plants.*

Number of family	Treatment	Number of dwarf plants	Number of tall plants
Sc 17–IS	Selfed	22	--
18–IS	Selfed	17	--
19–IS	Selfed	24	--
20–IS	Selfed	24	--
21–IS	Selfed	46	--
23–IS	Selfed	44	1
24–IS	Selfed	46	--
25–IS	Selfed	24	--
26–IS	Selfed	47	--
27–IS	Selfed	24	--
28–IS	Selfed	46	1
29–IS	Selfed	48	--
Total selfed		416	2
Sc 17–OS	Open fertilized	15	4
18–OS	" "	13	3
19–OS	" "	11	6
20–OS	" "	15	5
23–OS	" "	19	2
24–OS	" "	13	2
26–OS	" "	9	2
27–OS	" "	8	1
28–OS	" "	17	6
33–OS	" "	15	1
Total open fertilized		135	32

SUMMARY.

1. A new dwarf sweet clover has been found at Brandon Experimental Farm.

2. This dwarf character is inherited as a simple recessive to the normal type.

3. Its origin points to the mutation of a single factor.

4. Dwarf sweet clover crosses naturally with normal tall sweet clover to the extent of ten or twenty per cent.

5. This Dwarf Sweet Clover might or might not prove to be of economic importance. Its fine habit of growth, however, warrants a thorough test of its commercial qualities.

DOMINION EXPERIMENTAL FARM,
BRANDON, MAN.

LITERATURE CITED

1. KIRK, L.E. Aberrant Forms in Arctic Sweet Clover. Scientific Agriculture *5;* 113-116, 1924.

2. ————. Segregation in Aberrant Sweet Clover Forms. Scientific Agriculture *6:* 233-235, 1926.

A CHEAP AND EFFECTIVE FLY SPRAY.

C. R. Twinn and F. A. Herman

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There are several species of flies which, during the warm summer and autumn months congregate in houses and other buildings. Of these, the common housefly, *Musca domestica* L., is probably the most widespread, abundant and annoying, and owing to its habit of breeding in, and frequenting filth, such as various kinds of manure, human faeces and garbage and to the fact that it may convey infectious diseases, constitutes a menace to public health. The housefly is particularly objectionable in that it frequently passes directly from filth to human food carrying bacteria and particles of decomposing organic matter on its hairy body and legs, and sticky feet and mouthparts.

Undoubtedly the most effective and desirable method of controlling these flies is to do away with their breeding places by properly treating or disposing of such materials as manure and garbage. It will probably be many years, however, before the adoption of such ideal control measures will become universally practicable, and in the meantime any cheap and efficacious method of destroying the adult flies, such as by the use of fly sprays, is of considerable value. With the object in view of producing a fly spray that would be effective, cheap and easily made, a number of different chemical mixtures were prepared and tested as to their relative effectiveness against flies, at the Central Experimental Farm, Ottawa, during August and September, 1927. Ideal conditions for such experiments were found in two small rooms each of about 1,000 cubic feet capacity adjoining a large barn in which were housed a considerable number of dairy cattle. These rooms were used at milking time to strain the milk, and thousands of flies congregated there, no doubt attracted by its odour.

As fly sprays operate best in a closed space, and in order to prevent the flies from escaping before the effect of the chemicals became apparent, the doors and windows of the rooms were kept closed while the experiments were in progress. The mixtures were sprayed in the form of a fine mist by means of an ordinary, small, cheap hand sprayer, the reservoir of which had a capacity of ten fluid ounces. The experiments were only carried out when the flies were present in the rooms in great numbers, literally in thousands. About three-quarters of a fluid ounce of liquid was used to each thousand cubic feet of space, the material being sprayed in all directions.

Five of the original mixtures tested contained pyrethrum and the others did not. None of the mixtures in which pyrethrum was absent proved effective enough to be considered satisfactory. Their formulae were as follows: (1) cresylic acid, 10 cc., oil of cloves, 6 cc., kerosene, 84 cc.; (2) toluol, 10 cc., xylol, 10 cc., benzol, 5 cc., oil of citronella, 3 cc., kerosene, 72 cc., (3) turpentine, 10 cc., methyl salicylate, 8 cc., kerosene, 82 cc.; (4) toluene, 5 cc., methyl salicylate, 3 cc., kerosene, 92 cc.; (5) carbon tetrachloride, 6 cc., oil of cassia, 3 cc., kerosene, 91 cc.; (6) beechwood

creosote, 15 cc., methyl salicylate, 3 cc., kerosene, 88 cc.; (7) derrinol, consisting of a 5 per cent alcoholic extract of derris; (8) hydrated lime, 60 grams, ammonia (15 per cent), 45 cc., gasolene, 60 cc., water 455 cc. to which had been added 5 cc. of a 1 per cent solution of saponin.

Spray number 1 greatly agitated the flies causing more than 50 per cent to fall within 15 minutes; sprays number 2, 3, 4, 5 and 6 brought down a very small percentage of the flies; sprays number 7 and 8 had apparently no effect at all. Very different results, however, were secured from the use of spray mixtures prepared from pyrethrum and kerosene.

Spray mixtures containing pyrethrum.

Formulae of Mixtures:	Effect on Flies:
1. A 10 per cent mixture of pyrethrum in cold kerosene. Agitated occasionally, allowed to stand 24 hours and the clear liquid filtered off.	The effect of this spray was to agitate the flies greatly, causing them to fall until at the end of a few minutes nearly all were down, their bodies littering window-sills and floors.
2. 10 per cent pyrethrum in kerosene prepared as above except that the pyrethrum was added to hot kerosene and agitated while cooling.	Effect similar to the above, the majority of the flies, after a brief period of intense activity, being brought down within a few minutes of application.
3. 1.7 per cent solution of pyrethrum in kerosene 55 cc. Ethyl acetate 25 cc. Methyl salicylate 3 cc.	This spray owing to the smaller percentage of pyrethrum used, was slower in action than Nos. 1 and 2, but brought down nearly all the flies within 10 minutes. Many of these recovered, however, within half an hour. The strong odour of the ethyl acetate is undesirable.
4. 10 per cent solution of pyrethrum in alcohol from which the pyrethrum residue had been filtered 70 cc. Gasolene 30 cc.	This material was decidedly less effective than any of the three preceding, owing to the substitution of alcohol for kerosene. It did not agitate the flies like the other mixtures and was slower in action, several minutes elapsing before the flies commenced falling. At the end of 15 minutes about 75 percent of the flies were down.
5. 10 per cent pyrethrum — alcohol solution as above, treated with sodium hydroxide.	No apparent effect on the flies.

The results from the experiments tabulated above, which were repeated several times in the case of the pyrethrum-kerosene mixtures, indicate that pyrethrum extract is an effective agent for killing flies, and that kerosene, which by itself is useless as a fly spray, forms a satisfactory solvent for the active principal of pyrethrum. The results also indicate that there is no apparent advantage in heating the kerosene before adding the pyrethrum, thus simplifying the preparation of the spray.

It was next necessary to determine the minimum percentage of pyrethrum that could be used to secure the best results at a reasonably low cost,

and to compare it with the best of the proprietary fly sprays already on the market. Several of the proprietary sprays were tested and one, a well-known brand, which appeared to give the best results, was used for purposes of comparison. A number of solutions consisting of different percentages of pyrethrum in kerosene were also prepared. On testing these and the proprietary spray, it was found that all worked equally effectively in bringing down the flies with the exception of the weakest solution, prepared from 1 per cent pyrethrum in kerosene, which was slower in action than any of the others.

The effect of the pyrethrum-kerosene preparations, when sprayed in an infested room is to bring the flies into rapid motion immediately, many falling, until within a few minutes all are down, tumbling and spinning and showing signs of great distress, ovipositors and mouthparts extending and retracting, legs twitching and wings feebly vibrating. Many of the flies continue to show signs of life for several hours and usually a certain percentage eventually recover sufficiently to fly away. In order to discover what percentages recover from the effect of the various sprays, numbers of the helpless flies gathered up shortly after the application of the sprays were placed in lamp-chimney cages for a period of twenty-four hours. The results from these observations are tabulated below.

Percentage of flies which recovered from effect of fly sprays

Pyrethrum—kerosene sprays* Percentage of pyrethrum	Number of affected flies under observation	Percentage that recovered within 24 hours
1.25	49	75.5
2.5	61	16.4
3.75	64	62.5
6.25	64	45.3
10 (prepared with hot kerosene)	135	20.2
10.	162	17.0
12.5	66	6.0
Proprietary Fly Spray	141	36.7

*Prepared with cold kerosene except where otherwise stated.

The above results are rather variable probably depending to some extent on the amount of spray with which the flies actually came into contact as well as on the strength of the spray material used. In general, however, they indicate that the stronger concentrations of pyrethrum extract cause the highest mortality, the recoveries being over 75 per cent in the case of the 1.25 per cent spray, and only 6 per cent in the case of the 12.5 per cent spray. They also show that there is no advantage in heating the kerosene, when preparing the spray, the percentage of mortality secured from the 10 per cent solution prepared with hot kerosene being slightly less than from the spray prepared with cold kerosene. The number of flies which recovered from the effect of the proprietary fly spray was 36.7 per cent, indicating this material to be rather less efficient than the 10 per cent pyrethrum-kerosene mixtures.

To test the efficiency of the pyrethrum-kerosene fly sprays in controlling flies in farm buildings such as live-stock barns, a large piggery was chosen, measuring about 35,000 cubic feet, in which flies swarmed in great numbers. All the windows and doors of this building were first closed,

and then a 4 per cent pyrethrum-kerosene mixture was sprayed about liberally by means of two small hand sprayers. The flies which swarmed in thousands on the windows, walls, floors, ceilings and pigs, immediately began to fall in great numbers, and at the end of fifteen minutes the majority were down, lying on floors and window sills. The kerosene irritated the skin of the pigs somewhat, and for several minutes they rubbed themselves on the floors and walls of their pens. The irritation soon disappeared, however, without leaving any apparent ill effects. Less than two quarts of spray were used in the whole building, but the treatment resulted in destroying a considerable proportion of the flies, which were swept up and thrown into hot water to prevent any from recovering.

Conclusions.

For all practical purposes, a 6 per cent pyrethrum-kerosene spray is quite satisfactory. This is prepared by adding one-half pound of pyrethrum to one gallon (8.08 lbs.) of kerosene, allowing the mixture to stand and agitating it at intervals over a period of about two hours, thus ensuring that practically all the active principal of the pyrethrum is dissolved. The residue of the pyrethrum settles to the bottom of the vessel as a brown sediment, and the clear liquid, which is pale lemon-yellow in colour, may either be syphoned or filtered off. When the spray is required for use in farm buildings, it may be satisfactorily prepared with ordinary kerosene and it is unnecessary to add any other chemicals. For household use, however, to remove any possibility of staining fabrics or furniture, water-white kerosene should be used, and, in order to impart a pleasant odour, methyl salicylate may be added at the rate of three fluid ounces to each gallon. The spray should be kept in a tightly corked container to prevent it from deteriorating in strength, as the active principal of pyrethrum is volatile.

Pyrethrum varies in price from 50 to 90 cents a pound, wholesale, so that based on the highest wholesale price quoted, the cost of the spray per gallon is as follows:

For Farm Buildings:		*For Household Use:*	
		Pyrethrum ½ lb.	.45
Pyrethrum ½ lb.	.45	Water-white kerosene, 1 gal.	.30
Ordinary kerosene, 1 gal.	.20	Methyl salicylate (75c per lb. wholesale) 3 fl. ounces (approx.)	.17
Cost per gal.	.65	Cost per gallon	.92

The above prices for pyrethrum and methyl salicylate were quoted by a firm of wholesale druggists, and would probably be about 50 per cent higher if purchased retail. The cost of this spray, whether the materials are purchased wholesale or retail, is, however, very low, and as only about three-quarters of a fluid ounce of spray are required to treat each thousand cubic feet of space, its use is very economical. In using this spray it is advisable to sweep up the dead and dying flies shortly after the application and to either burn them or throw them into hot water, as otherwise a certain percentage is liable to recover.

This spray should find wide application wherever flies are troublesome under indoor conditions, such as in cattle barns, stables and unscreened houses, and, as it has been observed to kill other species of insects, it should also prove useful in destroying other household insect pests.

Although tests have indicated that this material when in the form of a fine spray, is not very inflammable, it is advisable never to use it where there is danger of fire, such as in the presence of a naked flame.

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POTENTIALITIES OF SWEET CLOVER AS PLANT BREEDING MATERIAL.*

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The phenomenal success of sweet clover as a recently introduced cultivated crop probably never has been equalled. Its wide adaptation and varied uses place it in a unique position. There is scarcely a province or state from the Atlantic Ocean to the Rocky Mountains and from Texas to the Peace River where sweet clover is not proving an asset to the farmer. The acreage seeded to this crop is much greater in some districts than in others, but who can estimate the future possibilities of this productive legume, when all of its potentialities have been exploited? Agronomists and plant breeders are now taking the sweet clover crop seriously and evincing a keen interest in its culture and development.

This paper was prepared with the object of reviewing, in a general way, the status of sweet clover with respect to varietal differentiation and adaptation, together with the nature and extent of the variability which occurs normally in common white and yellow flowered sweet clover. Reference will be made to some exceptional forms of sweet clover, which were obtained as segregates in the progenies of certain aberrant sweet clover plants. As these plants were described two years ago at the annual meeting of this Society, it is believed that something in the nature of a progress report may be of interest at this time. Finally the mode of pollination in sweet clover and its relation to the technique of breeding improved varieties will be discussed briefly.

Varietal Differentiation.

The number of distinct varieties of sweet clover is very small and these have only been recognized during the last few years. These varieties constitute a very small proportion of the total production. Most of the seed, used at the present time, is classified simply as common white or common yellow flowered sweet clover. Of the white and yellow flowered species, the former is much more extensively grown but the latter is apparently on the increase. It was estimated recently that 90 per cent of the sweet clover grown in North Dakota is of the biennial white flowering type. In Western Canada the proportion of yellow flowered sweet clover is probably less than five per cent. In Montana and South Dakota, greater use is being made of the yellow flowered species. A yellow flowered variety also has found considerable favour in Ontario.

Those who prefer yellow flowered sweet clover to the white, claim that it is better for pasture purposes and that it makes a finer quality of hay. In this they may be correct. On the other hand, we have found that in general,

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the yellow flowered varieties are somewhat less winter-hardy than the white and the seeding habit is such that the plants are less easily controlled in that they are more liable to persist where they are not wanted.

Among the few varieties of sweet clover, that have become reasonably well established, may be mentioned "Arctic" and "Grundy County" of the biennial white flowered species; "Albotrea" and "Redfield Yellow" (S.P.I. 40937) belonging to the biennial yellow flowered species; and "Hubam," an annual variety of *Melilotus albus*. A considerable number of strains have been developed by selection, many of which we have studied, but none of them, to our knowledge, is grown to anything like the same extent as those mentioned. It is not to be said that some of these selections may not prove of great value. Most of them are of recent origin and still in the trial stage of development. Some are distinct in type and a few are fairly uniform with respect to conspicuous morphological characters.

The Arctic variety of white flowered sweet clover was developed at the University of Saskatchewan from seed which had its origin in Northern Siberia, where it was obtained by the United States agricultural explorer, Dr. N. E. Hansen. This variety belongs to the early mid-tall type. In the West it usually grows about five feet tall and ripens its seed earlier and more uniformly than common white flowered sweet clover. This last named characteristic probably accounts for its exceptionally good seed production. The plants are relatively fine stemmed. The variety is noted for its exceptional winter hardiness and it has shown an unexpected resistance to a root-rot organism, which apparently has caused extensive damage to stands of sweet clover in Western Canada, during the last few years.

The Grundy County variety had its beginning in Illinois from seed of unknown origin. It is extensively used in a part of that State and adjacent districts. This variety is similar to Arctic in that it is an early mid-tall type, but the first season it is distinctly different in habit of growth. It normally grows about five feet high and is noted for its heavy seed production. Although it comes from a long way south, this variety appears to possess considerable hardiness.

The variety of yellow flowered sweet clover, known as Albotrea, was developed and has been extensively distributed in Ontario. It is a good yielder and typical of the yellow flowered species in habit of growth.

"Redfield Yellow" is a strain of common yellow flowered sweet clover, that has found great favour with the farmers of South Dakota and Montana.

"Hubam" Sweet Clover is an annual variety of *Melilotus albus*. It was thought at first that a variety of sweet clover, which could be grown to maturity in one season, might prove very valuable and perhaps largely replace the common biennial form. However, extensive tests, by experiment stations throughout the continent, have shown conclusively that the annual form is less desirable than the biennial except perhaps for some special purposes.

This year the University of Saskatchewan Field Husbandry Department has increased a new variety of yellow blossomed sweet clover for the first

time and considerable seed is available for distribution. This variety has been named "Zouave". In habit of growth Zouave differs from common yellow flowered sweet clover, in that it grows erect the first year while the latter is more or less procumbent and also in that it retains its leaves much later in the fall than any other variety of white or yellow flowered sweet clover with which it has been compared. Zouave is an exceptionally strong grower the first year and a good yielder the second. The seed is densely mottled with purple. The plants are coarser than those of Arctic, and somewhat less hardy, being about the same as other yellow flowered varieties in this respect.

Tests at several experiment stations have resulted in very favourable comment. Its full agricultural value, however, can only be determined by extensive farm trials under different conditions.

Varietal Adaptation.

Little information is available with respect to the relative suitability of existing varieties to varied conditions of soil, climate and field management. This is only to be expected in the present state of our knowledge as to the sweet clover crop in general. The fact that the aforementioned varieties are grown chiefly in districts adjacent to that in which they originated is not, in itself, sufficient evidence of superior adaptation. However, indications are not lacking that sweet clover possesses a high degree of adaptation. In general the demand seems to be fairly insistent for a finer stemmed, more leafy type of sweet clover, possessing greater palatability. Northern districts, of course, will demand a considerable degree of winter hardiness.

Sweet clover is used for hay, pasture, silage and soil improving purposes. As a crop it is becoming increasingly evident that its greatest usefulness lies in its value for pasture. Graber *(2)* has published recently the results of some interesting experiments, which seem to indicate an important future for sweet clover as a pasture crop in that large Eastern area of the United States and Canada where bluegrass has long monopolized the field. It appears possible, under certain conditions, to establish stands of sweet clover in old blue grass sod, and by a system of deferred grazing, not only to augment the grazing capacity of the pasture but also to increase the yield of blue grass after the sweet clover has disappeared.

In the Northwestern section of the Great Plains area the tendency is to favour early maturing varieties, because it is recognized that seed production is an important consideration. A late immature crop of sweet clover is difficult to handle and returns an unprofitable yield of poor quality seed. On the other hand, in the East-central humid section of the United States, pasturage, during the summer months when blue grass is unproductive, is a prime consideration, creating a demand for a sweet clover variety, which will mature late and provide pasturage in midsummer. All of the varieties and types that are now available mature too early to fulfil this requirement. Those types which do mature latest, are invariably extremely coarse and very tall, which makes them difficult to handle for seed.

Under such circumstances lateness of maturity combined with absence of coarseness, is therefore the type most desired.

The very widespread interest in sweet clover, at the present time, seems to indicate that we have to deal with a legume of wide adaptation and large possibilities. It is perfectly obvious that any crop grown over such an extensive area, as is sweet clover, and used for a variety of purposes, is sure to offer the maximum opportunity for the development of improved varieties. It is altogether unlikely that the same varieties will be equally adapted to humid, semi-arid and irrigated farming districts. The same may be said with respect to the suitability of varieties for different soil types. Certain strains are said to be acid tolerant, and some more tolerant than others of alkali salts. The best varieties for pasture purposes may not prove the best for hay. Some are more winter-hardy and disease resistant than others. Simply to mention a few of these varied requirements, is sufficient to emphasize the need for varietal adaptation.

Variability in Sweet Clover.

From a consideration of the question of adaptation and practical requirements of the sweet clover crop, the attention is naturally directed to a consideration of the kind and degree of variability which is found within different species of *Melilotus*. It is not long since that *Melilotus albus* and *Melilotus officinalis* were regarded as fairly homogeneous in their make-up. Or, it would probably be more correct to say that sufficient interest had not developed in the crop to make a close study of variability, particularly necessary or interesting to the agronomist. Now this has all been changed. Different species, varieties and strains are being collected, grown

Figure 1. Part of the sweet clover nursery in 1925, showing first year's growth of alfalfa-like and typical sweet clover plants. This picture shows the progeny of a single individual only.

and observed with a view to learning all there is to be known about the natural variability in this crop.

Although this study of variability in cultivated species of sweet clover has been under way for a decade, it has only been seriously considered during the last three or four years. The Bureau of Plant Industry, United States Department of Agriculture, has been active in the introduction of many interesting types and is now engaged in studying them with a view to improved botanical classification. Such work is much needed at the present time. Mr. Kephart, who is in charge of sweet clover investigations for the United States Government, is at present overseas, acting in the capacity of agricultural explorer, in the interest of sweet clover investigation. The Canadian Seed Growers' Association is desirous of learning the degree of morphological similarity, which may reasonably be expected, within registered varieties of sweet clover at the present time and how the standard of uniformity may be improved. A sub-committee of the Forage Crop Plant Breeding section of the Association has this work in hand.

As the work of botanical classification and the study of variability, with respect to morphological and physiological characters, proceeds, there doubtless will be discovered many facts about sweet clover of scientific interest and practical importance. From the material, at present under observation, it may be said that there is no lack of striking variations in most plant characters. Some of these may be listed as follows:

Early maturity and late maturity.
Winter-hardiness and lack of winter-hardiness.
Dwarfness and tallness.
Fine stems and coarse stems.
Differences in yielding ability.
Differences in degree of disease resistance.
Differences in colour of foliage.
Differences in amount of leafiness.
Differences in shape of leaf.
Differences in persistance of foliage in the fall of the first year.
Differences in habit of growth in the first year.
Differences in palatability.
White pods and black pods.
Yellow seed and mottled seed.
Annual forms and biennial forms.

Some of the above characters are sure to be limiting factors in the use of certain varieties in a given environment. Most of the differences referred to are well defined in existing varieties and strains. With respect to leafiness and palatability, however, there are no data available which show that any variety actually has more leaves or less coumarin than the average. A year or two ago, a study of leaf percentage, coumarin content and total nutrients of five distinct types of sweet clover was published by Kirk *(6)*. A fall cutting and two cuttings of hay from the second year's growth were used for the determinations. Analyses were made by the Dominion Chemist, Experimental Farm, Ottawa. It was somewhat surprising to find that

all of the sweet clover types had approximately the same amount of foliage, the same amount of coumarin, and the same amount of protein and other food constituents. It was found in this experiment that white and yellow flowered sweet clovers were almost identical in each of these particulars. The results seem to indicate that types of sweet clover, which appear quite distinct, may be probably not very different in leafage and chemical composition.

In view of the natural variability occurring in sweet clover, it is reasonable to assume that in the early stages of breeding, greater progress can be made in securing suitable varieties, by working with a wide range of types than by extensive selection within the limits of one or two varieties or by confining the attention to commercial white or yellow flowered sweet clover from a single source.

Super-normal Variability.

In the course of breeding work with sweet clover, a number of exceptional forms have been discovered. These occurred among plants of the Arctic variety. The aberrant plants resembled biennial white flowered sweet clover, but differed from the latter in many respects. The greater number were sterile but a few fully fertile plants were found. Progenies from each of the fertile plants segregated into two main types, one of which was like typical white flowered sweet clover, while the other was characterized by a shorter and finer growth, numerous leafy stalks and a much-branched crown. Each parent plant produced a different type of aberrant progeny. The original plants and the behaviour of their progenies, during the first year of growth, have been described with illustrations in *Scientific Agriculture (3, 5)*.

The origin of these new sweet clover forms is a matter of speculation. Abnormal inflorescences accompanied by much sterility and clear cut segregation into sweet clover and alfalfa-like forms strongly suggest natural

Figure 2. Self-fertilized line of a promising new sweet clover type which was isolated from the progeny of one of the new forms described in the text. Second year's growth, 1927.

crossing between white sweet clover and some other kind of legume or else the occurrence of sweet clover mutations with which the normal plants subsequently cross-fertilized.

Owing to the lack of facilities it was possible to grow, in the first test, only a small progeny from ten of the aberrant plants. But since the publication of the preliminary reports already cited, a large population of plants from each original parent has been grown. In addition, thirty-five first generation selfed lines and nine second generation selfed lines from the alfalfa-like segregates have been studied. Each of these selfed lines contained from 70 to 100 plants. Altogether nearly 10,000 plants of this material have been grown. All of the plants were started in the greenhouse and transplanted into the field. This year, enough seed was available to sow 22 eight rod rows from as many individual plants representing several different types. Next year's results from this normal seeding is awaited with much interest.

These remarkable sweet clover plants are, to say the least, exceedingly interesting. What their agricultural value will be, it is impossible to say as yet, but they appear to possess many promising qualities.

A brief statement with respect to some characteristics of the plants in question may be of interest. All are biennial and have the typical flower, pod and seed of white flowered sweet clover. At least six very distinct types have been isolated and several selfed lines of each are being studied. These types differ very markedly from common biennial sweet clover, the difference consisting chiefly in the numerous shorter, leafy stems, which develop from multiple buds at the crowns. Some of the strains appear to be much less bitter than common sweet clover. There is great variation in time of maturity and also very striking differences in disease resistance. During the past summer, one selfed line was completely destroyed by "Stem canker" while an adjoining selfed line was almost immune. Abnormal inflorescences were found only in the case of the original sterile or semi-sterile parent plants. Most of the selfed lines appear to be fully fertile although some produce a heavier crop of seed than others and a small percentage of plants give evidence of partial sterility. Some of the strains have seeds which possess a characteristic colour and shape.

The chief interest, which belongs to these plants in relation to the subject matter of this paper, is the fact that variability in sweet clover is not limited to that which occurs normally in existing types and varieties. The plants described above exhibit an entirely new range of variation, which presents additional opportunities for the breeder of sweet clover and suggests that hybridization or mutation may be utilized in the future for the production of new types of great agricultural value.

Technique of Sweet Clover Breeding.

The results of controlled experiments to determine the degree of self-fertility possessed by *M. albus* and *M. officinalis* has been published by Kirk *(4)*. Elders *(1)* made a similar study and reached essentially the same conclusions. The data presented indicate clearly that white and yel-

low flowered sweet clover differ markedly in their ability to set seed without the aid of insects. This work was repeated again in 1927 by the writers with much the same results.

M. albus is apparently highly self-fertile and will set seed freely when insects are wholly excluded. This conclusion was further substantiated by growing plants to maturity in the greenhouse during the winter months. *M. officinalis* is probably unable to set seed freely unless the flowers are visited by insects, or what is less likely, the plants may be sufficiently sensitive to the artificial conditions resulting from caging, to prevent seed setting.

Hybrids between white and yellow flowered sweet clover do not appear to have been reported. Separate progenies of several hundred selected plants of both species have been studied by the writers, but in no case have they been found to segregate for white and yellow flower colour.

The fact that *M. albus* is perfectly self-fertile does not mean, of course, that considerable crossing may not be effected by insects. There is plenty of evidence that some natural crossing between plants within the species does occur, but the high degree of uniformity which is usually found within the progenies of open-pollinated single plant selections indicates that white flowered sweet clover is mainly self-fertilized under normal field conditions in Saskatchewan.

Cross pollination between plants of *Melilotus albus* may be much more frequent under other conditions. In a recent article Smith *(8)* presents definite evidence that where he worked (Michigan and Maine), natural crossing by bees is very common in white flowered sweet clover. He states that "When biennial plants in their second year of growth are grown near annuals, much crossing results from the visitation of insects, particularly bees. From a total of 227 pollinations by bees and possibly other agencies, 126 resulted in hybrid plants. In other words the chances for intervarietal pollination of sweet clover by bees are about equal to the chances for intravarietal pollination."

Cross pollination in sweet clover without doubt occurs frequently enough to necessitate selection within self-fertilized lines as a standard breeding procedure. Under certain conditions mass selection may be effective in the purification of adapted varieties.

Artificial self-pollination of sweet clover does not involve a great amount of labour. The writers are using two methods, both of which have given excellent results with the white flowered species. One method is to enclose the entire plant in a cotton cage which is supported by four posts; the other method is to enclose a few racemes with 4 x 12 inch parchment bags made with water-insoluble casein glue. These bags are improved for the purpose by having a number of very small perforations at the upper end to permit the passage of transpired moisture. The latter method requires much less expensive equipment and is the best to use where a small quantity of seed is required from each of a large number of plants. The bags are very durable and will stand much wind and rain without injury.

When a larger quantity of seed from each plant is desired the cotton cage is recommended. There is one serious difficulty, namely the risk of injury by aphids. These insects get into the cages, multiply very rapidly, and completely destroy the plants. During the past summer, over 50 caged plants were destroyed in this way. Next year it is the intention to overcome this difficulty by periodical fumigations within the cages.

The technique of crossing sweet clover presents considerable difficulty because of the smallness of the flower. Emasculation is a tedious process and one which it is not easy to accomplish in such a way as to insure successful pollination. The method proposed by Oliver *(7)*, which consists in removing the stamens with a jet of water, is perhaps the most satisfactory. Good results with this method were obtained by Smith *(8)* in his crosses between annual and biennial sweet clover. He advises emasculating the flowers in the afternoon and pollinating during the following forenoon, pollen being more abundant in the morning than at any other time.

Summary.

1. The varieties of sweet clover that have become reasonably well established are few in number. "Arctic" and "Grundy County" of the biennial white flowered species, and "Albotrea" and "Redfield Yellow" belonging to the biennial yellow flowered species, are probably most widely grown. "Hubam", an annual variety of *Melilotus albus* and "Zouave", a new variety of yellow flowered sweet clover, are distinct varieties of recent origin. A considerable number of new strains which have been developed by selection, are being studied. Some of these are distinct in type and a few are reasonably uniform with respect to conspicuous morphological characters.

2. Little information is available with respect to the relative suitability of existing varieties to varied conditions of soil, climate, and field management. Indications are not lacking, however, that sweet clover possesses a high degree of regional adaptation. In general the demand seems to be fairly insistent for a finer stemmed more leafy type, possessing greater palatability. Northern districts require, in addition, winter-hardiness

FIGURE 3. A few of the new sweet clover types described in the text. Second year's growth, 1927.

and early maturity, while further south and east a later maturing type is sought, the object being to provide summer pasturage at a time when bluegrass is least productive.

3. There is a wide range of variability to be found in sweet clover with respect to most plant characters. Owing to the phenomenal success of sweet clover as a cultivated crop, variability within different species of *Melilotus* is receiving much more study than has previously been the case. In the early stages of sweet clover breeding, it appears reasonable to assume that greater progress may be made in securing suitable varieties by working with a wide range of types than by extensive selection within the limits of common white or yellow flowered sweet clover from a single source.

4. Some exceptional types of sweet clover are described as to origin and characteristics. These were obtained as segregates in the progenies of certain aberrant sweet clover plants. Natural crossing and mutation are suggested as possible explanations of their origin. The plants are biennial in habit of growth and have the typical flower, pod and seed of white sweet clover. They differ from typical sweet clover chiefly in that they possess more numerous shorter leafy stems which develop from multiple buds at the crown. There are several types, some of which show considerable promise for cultivation. Early and late maturing strains with numerous fine stems have been obtained by inbreeding and selection.

5. *Melilotus albus* is highly self-fertile and sets seed freely without the aid of insects. Cross-pollination, however, occurs frequently enough to necessitate selection within self-fertilized lines as a standard breeding procedure. *Melilotus officinalis* sets very little seed when insects are excluded.

Self-pollination in *Melilotus albus* may easily be effected by caging the plants or bagging the racemes.

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LITERATURE CITED

1. ELDERS, A.T. Pollination and cytological studies of sweet clover, Sci. Agric. *6:* 360-365, 1926.
2. GRABER, L.F. Improvement of permanent bluegrass pastures with sweet clover, Jour. Amer. Soc. Agron. *19:* 994-1006. 1927.
3. KIRK, L.E. Aberrant forms in Arctic sweet clover, Sci. Agric. *5:* 113-116. 1924.
4. ———— Self-pollination of sweet clover, Sci. Agric. *6:* 109-112. 1925.
5. ———— Segregation in aberrant sweet clover forms, Sci. Agric. *6:* 233-235. 1926.
6. ———— A comparison of sweet clover types with respect to coumarin content, nutritive value, and leaf percentage. Jour. Amer. Soc. Agron. *18:* 385-392. 1926.
7. OLIVER, C.W. New methods in plant breeding. U.S. Dept. Agr. Bur. Pl. Ind. Bul. 167. 1910.
8. SMITH, H.B. Annual versus biennial growth habit and its inheritance in Melilotus alba. Amer. Jour. Bot. *14:* 129-146. 1927.

PLANT DISEASES NEW TO MANITOBA.*

G. R. Bisby and I. L. Conners

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Manitoba is a comparatively new agricultural area, especially as regards crop plants other than the cereals. There are no other crop areas to the north or east. Manitoba marks a part of the northern boundary of cultivated plants. We have made an especial effort to detect plant diseases soon after they arrived here, and to determine how effectively the fungi causing these diseases persisted in this climate. The records given here cover a few of the more important or interesting cases, and include some diseases that may give increasing trouble; in most cases the evidence indicates that these diseases had not occurred previously in Manitoba.

Late blight of potatoes *(Phytophihora infestans)* has been reported vaguely from Western Canada before, but we had never seen a specimen from Manitoba until the autumn of 1927. It was found at Portage la Prairie, Otterburne and Miami, the fungus being especially well developed on the Otterburne material. It has probably been brought into Manitoba many times in the past on potatoes, and perhaps a trace of the fungus may perpetuate itself here year after year. It is possible that during a series of successive damp seasons it might accumulate to such an extent as to render spraying necessary. It will be watched for with especial interest in 1928. The similar climate along the Red River in Minnesota and North Dakota has not been conducive to the development of the late blight, and it is probable that the dry atmosphere will prevent any serious outbreak in the Prairie Provinces. However, we have already found that the use of Bordeaux mixture on potatoes pays in Manitoba even in the absence of late blight, with an average increase of about ten bushels per acre per spraying. Potato growers may, therefore, protect themselves here without cost.

Downy mildew of grape *(Plasmopara viticola)* has not been recorded heretofore from Manitoba. It made its first appearance in the orchard at the Agricultural College in June 1927, and increased to such an extent as to cause considerable injury. It was also prevalent at Morden this year, and we had not seen it there before. We feel that it is threatening enough to render advisable the spraying of our grapes next spring. It may happen that in a drier season this disease, like the similar late blight of potato, will be held in check. We assume that the fungus reached us as spores carried in the air. It occurs commonly in parts of Minnesota.

The powdery mildew of clover *(Erysiphe Polygoni)* has attracted considerable attention during the past six seasons. In 1921 the disease suddenly appeared abundantly in the eastern States. In 1922 it spread over the central States, and reached Manitoba. In 1923 it was serious here. Resistant plants are noticeable in infected clover fields, and some of these were selected out for use in case the disease continued to be serious. The mildew was not found at Norway House, 300 miles north of Winnipeg in

*Part of a report given at the meeting of the Canadian Section of the American Phytopathological Society, Winnipeg, December 20-21, 1927.

1923. During 1924 and subsequent years the fungus has been present in southern Manitoba, but not especially serious.

The rust of red clover *(Uromyces fallens)* was also first found in 1922, and has persisted since. It is not a serious disease.

Onion smut *(Urocystis Cepulae)* was first found near Winnipeg by Professor W. P. Fraser in 1922. A little of it was collected in 1924, and more in 1925. During the past two years it has not been seen or reported. This smut continues to be rare here, despite the fact that onions are often planted successively on the same land. Onion smut is considered to be a disease of more northern regions, but nevertheless it appears not to thrive in Manitoba.

The powdery mildew of currants *(Sphaerotheca mors-uvae)* was first sent in from Cordova, Man., on August 21, 1924. It was collected on black currant bushes. There was only a slight infection, and no perithecia were present. In 1925, however, it was collected at Hazelridge on June 22 with perithecia present, at Brandon on July 3 and later at Valley River in the north and at Victoria Beach on the east side of Lake Winnipeg. All of these collections were on currants with the glandular leaves characteristic of *Ribes nigrum*. It has not been seen on either wild or cultivated gooseberries here. Apparently the fungus came into Manitoba about 1924; It has since been injurious to black currants each year. The mildew on gooseberry is evidently another physiologic form, and although it is indigenous to North America, appears not to occur in Manitoba.

The downy mildew of alfalfa (*Peronospora trifoliorum*) was found at Brandon in 1921 and at Winnipeg in 1923, and subsequently. It causes slight injury in local areas in alfalfa fields. It may have been present longer than our records show.

The leaf spot of alfalfa caused by *Pleosphaerulina briosiana* was found at Brandon in 1923. While it is of no economic importance, it is of interest to record the occurrence of this parasite, which is ordinarily considered to be limited to areas much farther south.

The anthracnose of peas *(Colletotrichum Pisi)* is another case of a disease scarcely to be expected in Manitoba. Chupp in his Manual of Vegetable Garden Diseases records it only from Ecuador, Japan, and Wisconsin. It caused some injury to garden peas at Brandon in 1923.

The brown rot of plums *(Sclerotinia)* is found in damp years such as 1922 and 1927. It seems to manage to persist, but does not find the climate congenial. It has probably been here for a number of years.

The ear or cob rot of corn caused by *Basisporum gallarum* is not uncommon, and has probably been present since corn has been grown in the province. It is noteworthy, however, that we have not yet been able to find *Diplodia Zeae* on corn in Manitoba.

The fungus *Sclerotinia sclerotiorum* is common in Manitoba. It has been found causing injury to sunflowers, red clover, alfalfa, carrots, parsnips, lettuce, dahlias, cucumbers, cabbage and on wild Canada thistle, nettle, sow thistle, and *Iva xanthifolia*. The sclerotia of course easily withstand our winters.

The downy mildew of spinach *(Peronospora effusa)* was first noted in 1926. It has, however, been found on wild lamb's quarters since 1920. This would seem to indicate that we have a native form on the weed, but that the form on spinach may be a distinct form and perhaps a new arrival.

A similar case is that of the downy mildew of cultivated sunflower (*Plasmopara Halstedii*) which has been found only in 1925, at Winnipeg. The mildew that passes under the same name may, however, be found each year on wild Compositae.

The leaf rust of barley *(Puccinia anomala)* was not very definitely found until 1927. In 1922 a few pustules bearing only red spores were found at Winnipeg, but we could not be certain that this might not have been some other leaf rust. In 1927 leaf rust was well developed on barley in several areas in Manitoba.

Snapdragon rust *(Puccinia Antirrhini)* was first collected at Winnipeg early in 1920, but a market gardener reported that he had seen it in 1919. This rust is native in the mountains of California, and was not found east of the great plains until 1913. It has been injurious here since 1920.

Corn rust *(Puccinia Sorghi)* was not found in Manitoba fields until 1922. It has been common each year since.

The Grand Rapids disease of Tomatoes, caused by *Aplanobacter michiganense,* was first collected at Brandon in 1927 and the typical non-motile bacteria producing yellow colonies were isolated This disease has been reported from the eastern and southern states, and also from British Columbia.

These examples indicate clearly that many diseases found elsewhere in North America, or in other parts of the world, may be expected sooner or later to reach Manitoba, and once they have arrived, the fungi are usually able to withstand our winters. The dry atmospheric conditions of Western Canada serve, however, as an effective check against certain diseases.

When agricultural crops are first grown in a new area, they may arrive without the diseases prevalent in localities where they have long been grown. This is illustrated by the case of tobacco, which has recently been cultivated to some extent at Morden. Aside from mosaic, we have been unable to find any disease on this crop; the leaves are beautifully free from spots caused by fungi. Yet doubtless the fungi will gradually arrive, as they did long since on cereals, and more recently on fruit, vegetable, and forage crops. As Manitoba grows older, more and more attention must inevitably be paid to the increasing number and prevalence of plant diseases. To be forewarned is to be forearmed, and growers who take intelligently into consideration the prevention of plant diseases will be amply repaid.

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AMERICAN PHYTOPATHOLOGICAL SOCIETY

CANADIAN DIVISION

Abstracts of papers submitted at the ninth annual meeting, held at the Dominion Rust Research Laboratory, Manitoba Agricultural College, Winnipeg, Man., December 20, 1927.

The Reaction of Wheat Varieties to Inoculations with *Ophiobolus graminis* Sacc.

R. C. Russell

Seventy-five varieties of wheat were inoculated in the greenhouse with a culture of *Ophiobolus graminis* Sacc., isolated from Saskatchewan field material. The inoculum consisted of a pure culture of the organism growing on moist ground oat hulls. Six grammes of this was spread in each six-inch pot at seed level when the wheat was being sown. Every variety was tested three times and a total of approximately 150 seedlings of each variety was exposed to infection. Each test lasted five weeks. At the end of this period the inoculated plants were stunted to about 40% of the height of the checks, and about 60% of them were dead. There were, however, slight but fairly consistent differences in varietal susceptibility noticeable. Good correlation coefficients were obtained between the percentage dead of each variety in the different tests. The resistance shown by the strongest of these varieties was not considered great enough to recommend their use in fields infested with take-all. (Dominion Laboratory of Plant Pathology, Saskatoon, Sask.)

Results of Experiments on the Control of Barley Stripe

J. E. Howitt and R. E. Stone

Barley Stripe, caused by *Helminthosporium gramineum* Rabh, causes very considerable losses in Ontario. The amount of stripe varies considerably in different years. In years when stripe is present different varieties vary in the amount of stripe present. Average of the three years 1924, 1926, and 1927 the amount was as follows: Common six-rowed 16.33%, Bearer (Ottawa No. 475) 6.67%, O.A.C. 21, 3.33%, Winnipeg No. 2, .33%.

In our treatments the hooded variety Success was used as it is susceptible to stripe. The following treatments were used: Semesan ¼ per cent solution soaked 2 hours at 22°C; Semesan ¼ per cent solution soaked 1 hr. at 45°C; Semesan dust 3 oz. per bushel; Uspulum ¼ per cent solution, 2 hrs. at 22°C, ¼ per cent solution 1 hr. at 45°C; Uspulun dust 3 oz. per bushel; Dupont No. 12 dust 3 oz. per bushel; Bayer's dust 3 oz. per bushel; copper carbonate 3 oz. per bushel; Vitriolene 3 oz. per bushel; formalin sprinkle 1 pt. to 30 gal. water. Dry formalin spray 1–1. The formalin sprinkle prevented germination. All the other treatments reduced the amount of stripe and also increased the yield.

Dupont dust No. 12 and the ¼ per cent solutions of Uspulun and of Semesan applied at 45°C. for an hour gave complete control. The other treatments were less effective.

It is necessary to continue these experiments in order to secure reliable results. (Ontario Agricultural College, Guelph, Ont.).

Progress Report on the Condition of Bulbs and Corms of Ornamental Plants Offered for Importation into Canada

F. L. Drayton

Inspection of foreign importations of nursery stock, including bulbs, etc., is performed by officers of the Dominion Department of Agriculture. The condition of many shipments of bulbs and corms was found to be highly unsatisfactory, and the question arose as to whether or not they should be admitted. A study of the literature threw astoundingly little light on the economic importance of the various troubles observed, and the want of reliable information necessitated careful research into the nature and significance of these injuries.

The bulbs and corms examined included the following: Tulips, narcissi, hyacinths, iris (bulbous), snowdrops, gladioli for spring planting, *G. nanus* types for forcing, crocus, and freesias.

The injuries were classified according to macroscopic characters and cultured. The types of injury are illustrated with lantern slides and their significance discussed in the light of present results. Among the known pathogens observed were *Bacterium marginatum* McC., *Bacterium Hyacinthi* Wakker, *Septoria Gladioli* Pass., *Botrytis Tulipae* (Lib.) Hop., *Rhizoctonia Tuliparum* (Kleb.) Whet. et J. M. Arthur, a *Sclerotium* sp. causing a dry rot of gladioli, and frequently *Tylenchus Dipsaci* Kuhn, one of the common nematodes affecting bulbs. In addition, a number of *Fusaria* and Sclerotia-producing fungi, so far unidentified, have been isolated repeatedly from certain types of injuries. In many cases insect injury and improper handling, curing, etc. encouraged the development of saprophytic fungi, mites, etc., resulting in a more or less severe breakdown during storage and transportation. (Central Experimental Farm, Ottawa, Ont.).

Reaction of *Linum* Species of Various Chromosome Numbers to Rust and Powdery Mildew

A. W. Henry

Linum species representing several groups based on chromosome numbers, for example *Linum grandiflorum* (2x=16), *L. perenne* (2x=18), *L. angustifolium* (2x=30 or 32) and *L. catharticum* (2x=57?) were used in these studies. Certain strains of *L. usitatissimum*, *L. angustifolium*, *L. crepitans*, *L. rigidum*, and *L. sulcatum* proved completely susceptible, while other strains, at least of the first two species as well as *L. perenne*, *L. austriacum*, *L. grandiorum*, *L. flavum*, and *L. catharticum*, proved immune when inoculated with *Melampsora lini liniperda* from *L. usitatissimum*. *Melampsora*

Lini cathartici from *L. catharticum*, a rust supposedly confined to that host, also infected *L. rigidum* normally, but all other species of *Linum* tested were immune. An *Oidium* sp. which developed abundantly on all varieties of *L. usitatissimum* tested in the greenhouse at Cambridge University, England, also produced identical symptoms on *L. angustifolium* and *L. crepitans*. All other species tested proved immune except *L. perenne, L. austriacum,* and *L. rigidum*, which developed traces of infection but which are apparently highly resistant. The results of the inoculations with *M. Lini liniperda* and *Oidium* sp. support previous evidence from crossing experiments and chromosome counts, that *L. angustifolium* is the wild ancestor of *L. usitatissimum*. They also indicate that *L. crepitans* is closely related to these two species. (Department of Agriculture, Edmonton, Alta.).

The Haustorium of *Cuscuta Gronovii*

E. M. Moss

Haustorial connections of *Cuscuta Gronovii*, Willd. with the following hosts were examined: *Monarda mollis* L., *Lathyrus ochroleucus* Hook., *Artemesia gnaphalodes* Nutt., and *Symphoricarps racemosus* Michx. Uninterrupted union between the xylem strands of host and parasite is made by haustorial tracheids, as described by earlier investigators of *Cuscuta;* but connections between phloem strands of host and parasite by sieve tubes in the haustorium do not seem to occur. Haustorial hyphae, each with a single, hypertrophied nucleus, commonly penetrate the host phloem, where they effect considerable destruction of tissue and ramify in a coralloid fashion, some of the branches entering the host cells and others insinuating themselves amongst the cells. Other hyphae may penetrate series of cells in the cortex or in the pith of the host. The haustorium and stem of the parasite contain starch in abundance while the host tissues have little, if any, of this carbohydrate. The enlarged penetrating hyphae commonly contain numerous minute starch grains. (Department of Agriculture, Edmonton, Alta.).

Physiologic Forms of Wheat Stem Rust in Canada

M. Newton, T. Johnson and A. M. Brown

By greenhouse experiments, twenty-four physiologic forms have been shown to be present in Canada. Five of these forms are different from those reported by Stakman and his co-workers in the United States. Some evidence has been found suggesting a possible relationship between the varieties of wheat grown and the distribution of physiologic forms of rust.

In the course of determining the physiologic forms in 1927, thirty-three separate cultures of aeciospores from barberries, all but one of which had been artificially inoculated, were transferred to wheat plants in the greenhouse. In fourteen of these wheat cultures, some greyish-brown pustules appeared. These were obtained in pure culture, and, as in the earlier case reported in *Phytopathology* 17:711-725, 1927, they have remained constant in colour, producing only greyish-brown uredinia. For most of these barberry infections telia from *Hordeum jubatum* were used as a source of inoculum. (Dominion Rust Research Laboratory, Winnipeg, Man.).

Treatment of Millet Seed to Prevent Smut

R. E. Stone

Millet smut is a common disease of foxtail millets in Ontario. Disease caused by the fungus *Ustilago Crameri* Koern.

Seed from a badly smutted crop was treated in several ways. The untreated seed gave a crop 56% smutted. Formalin sprinkle and formalin soak prevented germination of seed. Dry formaldehyde treatment markedly reduced the amount of smut but also checked germination to some extent. Bluestone soak and Bayer's dust were not effective. Semesan, ¼% solution, and Uspulun, ¼% solution, were quite effective, reducing amount of smut to 1.9% and .9% respectively. Dupont No. 12 dust reduced the amount of smut to .6%, while copper carbonate reduced the amount of smut to 1%.

These experiments will be continued. (Ontario Agricultural College, Guelph, Ont.).

Sexual Behaviour of *Puccinia graminis*

J. H. Craigie

An experimental investigation upon sex in the stem rust fungus has demonstrated that it is heterothallic. The sporidia are of two kinds, (+) and (−). A (+) sporidium gives rise to a (+) mycelium and a set of pycnia which produce (+) pycnospores. A (−) sporidium gives rise to a (−) mycelium and a set of pycnia which produce (−) pycnospores. When a (+) sporidium and a (−) sporidium are sown close together on a leaf, the (+) and (−) mycelia resulting therefrom intermingle and produce diploid aecia. When (+) pycnospores are brought into contact with (−) pycnia, or (−) pycnospores with (+) pycnia, diploid aecia are produced on the under side of the pustule receiving the pycnospores, within a few days of the transference. There is therefore the possibility of two different strains of this rust crossing and producing a new physiologic strain of rust. The experimental results will be found in *Nature*, Vol. 120, No. 3012, and No. 3030, 1927. (Dominion Rust Research Laboratory, Winnipeg, Man.).

Physiologic Forms of *Puccinia graminis Avenae* Erikss. & Henn. in Canada

W. L. Gordon

In 1924, Bailey reported the occurrence of five physiologic forms of *Puccinia graminis Avenae*. Forms 1, 2, and 5 were found to be present in Canada.

More extensive collections of oat stem rust were made during 1925-1927. Forms 2 and 5 have predominated each year. Form 1 has been isolated infrequently.

A study of the heterogeneous or X reaction, given by Form 5 on two differential hosts, was made by the single spore method. The heterogeneous reaction occurred again, when inoculations were made with single spore cultures.

Physiologic forms more virulent than 1, 2, and 5, first collected in 1925, have appeared each year. Form 3 has been collected once, but Form 4 has appeared more frequently. A collection from Paskwegin, Sask., in 1925, yielded a form which differs in its infection capabilities from all other forms yet reported, in being able to infect heavily all differential hosts. It is considered new, and has been named Physiologic Form 6.

Seedling tests for rust resistance, of some 230 varieties or strains of oats from various sources in America, as well as more than 100 varieties from France, Germany, Sweden, and Russia, have been carried out in the greenhouse, to physiologic forms 4 and 6. All were quite susceptible to form 6, and only one variety, from France, gave any indication of resistance to form 4. In a field test, these forms appeared to be equally virulent. (Dominion Rust Research Laboratory, Winnipeg, Man.).

A Seedling Blight Disease of Oats Caused by *Fusarium culmorum*.

P. M. Simmonds

The symptoms of the disease were described. Some observations on penetration and invasion of the oat seedling were reported. Penetration may take place through the mesocotyl or coleoptile. The fungus particularly invades the cortical tissues. Mycelium may collect between the coleoptile and plumule. At the crown, tiller buds may be invaded as well as root primordia. Some evidence has been obtained that entrance may take place through root hairs. (Dominion Laboratory of Plant Pathology, Saskatoon, Sask.).

Sulphur Dusting for the Control of Leaf and Stem Rust in Manitoba: Winnipeg Small Plot Experiments

F. J. Greaney and D. L. Bailey

(Published in full in this issue. Editor.)

Sulphur Dusting for the Control of Leaf and Stem Rust in Manitoba: Field Trials with Horse-drawn and Aeroplane Dusters.

D. L. Bailey and F. J. Greaney

(Published in full in this issue. Editor.)

The Dwarf Leaf Rust of Barley in Western Canada (*Puccinia anomala*, Rostr.)

A. M. Brown and M. Newton

This rust was first collected in Western Canada in 1922, but was not again found until this year, when it was quite abundant in South Western Manitoba, and also at Indian Head, Saskatchewan.

Urediniospores were germinated in hanging drops of distilled water, at different temperatures. The optimum for spore germination appears to be from 11°C to 17°C.

Urediniospores were kept in the laboratory at room temperature, and gave good germination at the end of a month; at the end of three months no germination was observed. (Dominion Rust Research Laboratory, Winipeg, Man.).

Cereal Diseases in Alberta in 1927

G. B. Sanford

Following are given the chief results of the first extensive plant disease survey in Alberta. More than a trace of stem rust on wheat rarely occurs in Alberta. However, under the extremely favorable conditions, abundant moisture and a prolonged ripening period, an unusual amount of this rust developed over the entire area, from the northern limits of the survey (Athabasca) to the Montana boundary. Actual shrinkage occurred in the Camrose area, but very little injury elsewhere. Slight infection of stem rust of oats developed as far south as Lethbridge and north to Edmonton. Leaf rust of wheat was very prevalent and in many cases severe. Stripe rust (*Puccinia glumarum*) was found again at Olds on the leaves and glumes of wheat, and on nearby *Hordeum jubatum*, and also in wheat fields and on *H. jubatum* in the extreme south of the province. Glume blotch of wheat (*Septoria glumarum*) was very prevalent and severe. Slight infections of basal glume rot (*Bacterium atrofaciens*) and also of what appears to be black chaff of wheat (*B. translucens*) were collected at diverse points. Root rots of wheat were severe and are the most important plant diseases of Alberta, causing a loss estimated to be about 7,000,000 bushels. A distinct correlation of the severity of root rots with the black soil type was noted. (Dominion Research Laboratory, Winnipeg, Man.).

The Occurrence of Yellow Stripe Rust in Western Canada

T. Johnson and M. Newton

Stripe rust (*Puccinia glumarum*) was discovered at Edmonton, Alberta, in 1918, by Prof. W. P. Fraser. Since then it has occurred annually on *Hordeum jubatum* in certain localities in Alberta. On barley it has been found once only. On wheat it was first observed in 1926 at Olds, Alberta, and again in 1927. Other hosts found naturally infected are *Agropyron Smithii* and *Agropyron tenerum*. The area in which stripe rust has been found now includes scattered localities from Edmonton to the international boundary as well as southwestern Saskatchewan.

Attempts were made to determine whether the rusts on *H. jubatum* and on wheat were the same form or two distinct specialized forms. Difficulty was experienced in establishing greenhouse cultures of the rust, probably on account of poor spore germination. Finally two cultures were established, one from wheat, the other from *H. jubatum*. Both of these proved to belong to the *P. glumarum Tritici* form. Although this does not prove that only that form exists in Canada, it shows that the rust on *H. jubatum* may under favorable conditions affect wheat.

Owing to difficulties in obtaining artificial infection, an attempt was made to determine optimum conditions for germination of fresh urediniospores produced in the greenhouse. Various methods were used at 10°C, 15°C, 17°C, 19°C, and 23°C, but under all conditions tried germination remained low and irregular. Germination was best at 10°C and 15°C, the average being only about 8 per cent in each case. (Dominion Rust Research Laboratory, Winnipeg, Man.).

Plant Diseases New to Manitoba

G. R. Bisby and I. L. Conners

(Published elsewhere in this issue. Editor.)

THE PERSISTENCE OF A POISONOUS RESIDUE ON FOLIAGE SPRAYED WITH NICOTINE SULPHATE.

A. Kelsall and F. A. Herman

[Received for publication December 16, 1927.]

Introduction.

Nicotine, used as a spray, has generally been regarded solely as a contact insecticide acting practically instantaneously, with little or no residual effect. Evidences that nicotine does not entirely volatilize, and that sprayed foliage remains to some extent poisonous, have occasionally been noticed. An incident is recalled, related by the late Prof. W. Lochhead, of an occasion when a bed of greenhouse lettuce was treated with nicotine and of the subsequent sickness of several ladies and a few men (non-smokers) following the eating of the lettuce. Mr. F. C. Gilliatt informs us that he once attempted to transfer European apple suckers to apple seedlings which had been sprayed several days previously with nicotine, and that after repeated attempts with many specimens he was unable to get any to live on the seedlings, although he had no difficulty whatever in transferring these insects to seedlings which had not been treated. Observations made by us during the past few years indicate that the poisonous residue on sprayed foliage may be of considerable consequence.

Field Evidence on the Persistence of Nicotine.

The eye-spotted bud-moth (*Spilonota ocellana* D. & S.) is quite susceptible to nicotine and one of the methods of control consists in spraying the under-leaf surface with nicotine at any time between July 15 and August 10, that is, just prior to or shortly after the hatching of the eggs. However, nicotine applied much earlier than this will give a certain measure of control. We have repeatedly demonstrated that nicotine applied long before eggs are present, even before the adults make their appearance, will kill newly hatched larvae several weeks or even a month later. The following are two typical examples, the first being taken from a 1926 experimental area, and the second being an average from duplicate plots in a 1927 experimental area.

Table 1

Material	Date of spraying	Date of moth emergence	Date of egg laying	Date of egg hatching	Date records taken	Average No. of living larvae per 100 leaves
Nicotine sulphate 1 qt. per 100 gals.	July 1	July 6 to Aug. 1	July 9 to Aug. 3	July 19 to Aug. 12	Aug. 10	18
Check	Not treated					132
Nicotine sulphate 1 pint calcium caseinate 1 lb. per 100 gals.	June 30	July 1 to Aug. 1	July 4 to Aug. 3	July 14 to Aug. 12	About Aug. 15	10
Check	Not treated					47.4

In explanation of Table 1 it may be said that the sprays applied did not deter the moths from depositing eggs on the treated areas. As many eggs were laid as on the untreated trees, and further these eggs hatched in a normal manner. On the trees which had been treated, however, the larvae died shortly after hatching, and numerous dead larvae could readily be found. Here then, is fairly positive evidence of a persistent poisonous residue, resulting from the application of nicotine sprays. It may be added that we have found the same to hold true whether nicotine sulphate be used alone, or in combination with calcium caseinate, hydrated lime, Bordeaux mixture, or lime-sulphur, though we have not sufficient data to say that the poisonous residue persists equally in all these mixtures.

Chemical Determinations.

We do not know whether the poisonous residue is an oxidation product of nicotine, a nicotine compound, or some other related material, but it was found that foliage previously sprayed gave positive tests for nicotine. Accordingly, the nicotine was determined on a number of groups of 500 leaves, Table 2 being self-explanatory. The A. O. A. C. silicotungstic acid method of analysis was followed.

Table 2

Material used	Date of Application	Date of Collection	Intervening Rainfall	Nicotine (as alkaloid) per 500 leaves
Check No treatment		—	—	—
Nicotine sulphate ½ pint, 10 lbs. hydrated lime per 100 gallons	July 28	Aug. 5	3.12 in.	8.5 mg.*
"	Aug. 4	Aug. 5	nil	4.3 mg.
Nicotine sulphate ½ pint, 1 lb. calcium caseinate, per 100 gallons	July 28	Aug. 5	3.12 in.	5.4 mg.
"	Aug. 4	Aug. 5	nil	4.3 mg.
Nicotine sulphate ½ pint per 100 gallons	July 28	Aug. 5	3.12 in.	2.9 mg.
"	Aug. 4	Aug. 5	nil	5.4 mg.
"	June 30	July 25	5.13 in.	0.9 mg.
"	June 30	Aug. 5	7.37 in.	1.1 mg.
"	July 22	July 25	1.26 in	2.6 mg.
"	July 22	Aug. 5	3.50 in.	2.8 mg.

*The precipitate of nicotine silicotungstate was of a brick red color and amorphous, with this sample, differing from the typical precipitate. The next sample showed traces of the same condition.

The results shown in Table 2 are not very consistent, but it must be remembered that spraying is apt to be quite uneven, and the results obtained would be rough approximations at the best.

Five hundred leaves similar to the above were dipped, and it was noted that 410 c.c. of solution were required to produce a similar degree of "wetness" as foliage sprayed in the field. This would be the equivalent of 123.0 mgs. of nicotine, (using ½ pint nicotine sulphate (40%) per 100 gallons). That is to say, the nicotine residue found on leaves a few days after spraying, is about the order of 5% of that originally applied.

General Conclusions.

Commercial nicotine sulphate (40% nicotine) used in sprays on foliage, leaves a fairly persistent poisonous residue of the order of about 5% of the nicotine originally applied. This residue is of importance from the standpoint of the control of at least one major apple pest.

Dominion Entomological Laboratory,
Annapolis Royal, N.S.

BOOK REVIEWS.

DER FLACHS ALS FASER-UND ÖLPFLANZE—(FLAX FOR FIBRE AND OIL). Tobler, Friedrich. 71 text illustrations; 273 pp; Berlin, Julius Springer, 1928. 8vo.

This appears to be a most comprehensive and valuable contribution to our knowledge of the principles of the flax industry. The only drawback—if so it may be called—is that the book is written in the German language. Prof. Tobler, formerly the Director of the well known Sorau Institute for research on fibre plants, has been fortunate in securing the co-operation of internationally known specialists, such as Bredemann, Director of the Institute for Applied Botany, Hamburg; Opitz, Director of the Institute for Field Husbandry of the Agric. Academy, Berlin; Rjaboff, of the Flax Experimental Station of the Agric. Academy, Timirjaseff, Moscow; and Schilling, Departmental Head, Research Institute for fibre investigation, Sorau. The book is intended not only to convey a precise idea of what is nowadays known about flax from the scientific research point of view, but also for the information and guidance of those who are interested in this ancient plant from the point of industry as well.

The subject is arranged into three main sections. First: the flax plant in general; with chapters dealing with the botanical features of various types and species of the genus *Linum*; types referring here to fibre and oil types and to strains within these. Chapter two deals with the internal structures of the plant. Reference is made to the significance generally of fibres in plants and flax particularly. Then follow discussions of the individual fibre cell, the length and strength of flax fibre, growth and structure of the plant in relation to environment and habitus and structure as influenced by breeding. The second section is devoted to flax in agriculture, viz: breeding, technique, and the present status of flax improvement. The history of cultivation follows together with a review of the world regions where grown. Chapter six deals very exhaustively with the question of cultural requirements, viz: climate and soil, preparation of soil, rotation, effect of fertilizers, the seed itself, the production of the best types of seed flax, and the quantity to be sown. Chapter 7 is exceedingly instructive, inasmuch as it is perhaps the most comprehensive account now available on the diseases, principal insect pests, and general related difficulties encountered. Dr. Schilling deserves particular credit for this valuable contribution. The weeds, generally, and weed seeds in flax seed are also dealt with, and methods for the control of all these "untoward conditions" are freely given.

The third section divides itself into four extensive chapters dealing with the harvest of the flax straw, of the seed, the flax straw and its uses, including a general survey of the methods of retting, chemical retting processes, breaking and scutching, the utilization of the "chaff", and the manufacture of paper from the fibre. It concludes with a treatment on the seed and its uses, viz: the structure and contents of the seed, the types of flax for oil, linseed oil, linseed feeding cakes and linseed meal, the use that may be made

of the gelatinous substance in the seed and of the chaff from the seed bolls. A most useful and extensive Bibliography on flax, covering the world literature, is appended, and the book closes with a good index.

Canada, it may be noted, is represented in the literature by but four references. It is to be hoped that we soon may be able to impress our European colleagues with a similar memoir dealing exhaustively with the present status of the flax industry in Canada and its potential possibilities. A book like the one discussed would certainly be a most welcome stimulus to our own industry, besides being the most interesting and exhaustive treatment on flax in general that has been published anywhere within recent years.

H. T. G.

HANDBUCH DES KARTOFFELBAUES (Handbook of Potato Growing). Dr. Th. Remy, 2nd edition. 87 Text figures. 312 pp. 8vo. Published by Paul Parey, Berlin, 1928. Gold-marks: 13.00 ($3.10).

The potato is verily coming into its own. Wm. Stuart's book on "The Potato—Its Culture, etc." published in 1923, (with a 2nd edition in 1927); Redcliffe N. Salaman's "Potato Varieties" published 1926; Thomas P. McIntosh's "The Potato—Its History, etc." published in 1927, and now comes Remy's 2nd edition in 1928. Everyone of them is a standard work, well worth a place in any library. Remy is in a position to speak with authority on the present status of potato growing in Germany. His "Kartoffelbau" of 1909 has made a strong appeal, but is surpassed by the new handbook as a second edition of the former. To us in Canada, it is especially instructive and the lifting of the veil of the "marvellous"—for thus was potato culture in Germany always regarded by outsiders—constitutes a welcome revelation.

The chapter on the economic importance and condition of the German potato industry is most instructive. Among the hoed crops, the potato takes first place in Germany—in this it does not differ from Canada—it occupies 9.8% of all arable land and constitutes 64.6% of the area under hoed crops.

Phenomenal total yields are obtained, amounting to 758,000,000 cwt. (in 1925 to 919,000,000 cwt.) of a value from $370—490,000,000. Poland is next with 642,000,000 cwt.; France produces 335,000,000, the U.S.A. 195,000,000 and Canada 60,000,000 cwt., or about as much as the production of Belgium. These figures make one reflect. It is not so much the size of the country as its population that counts. The average harvest for five years per acre in Germany is 106 cwt., in Canada 94 cwt. The use of certified seed throughout Canada would soon outclass this average, which is by no means phenomenal. We have produced in Canada 400 to 800 cwt. per acre—but so have the Germans—this only by the way. The Germans eat per capita about 4 cwt., which is about 1 cwt. more than Canada, and feed to stock 260,000,000 cwt., which seems almost unbelievable as compared with the use of 240,000,000 cwt. for human consumption. 46,000,000 cwt. are used for industrial purposes, pretty nearly the total production of Canada in some years. Germany admits 10% wastage of crop—Canada 2%—I believe both are wrong, especially Canada.

In the feeding of potatoes, the following example may be given:—

"It is hereby determined, that the potato as feed for fattening pigs "renders phenomenal service, providing it is augmented by the addition "of suitable albuminous substances. Of classical simplicity is the rapid "fattening method with potatoes, proven and recommended by Lehmann, "by which method pigs received daily from an age of four to five months, "700 g. coarsely ground barley, 200 g. gound meat- and 100 g. fish- meal "and as many boiled potatoes as they could take. Rations of this composi- "tion resulted in 20 weeks in an increase of weight of about 224 lbs." (1 oz. equals 28 g.). How such a method would work in the production of bacon pigs, is not being dealt with. Bacon is not extensively produced in Germany.

Feeding experiments with the dry tops as part of the roughage have been carried out—to us this indeed would seem truly "rough". In Canada we poison our tops very scientifically and then burn them up. In Germany they have no Colorado beetles to kill, and they don't spray so extensively for Late Blight as we do—hence they lose more every year in storage.

Large use is made in Germany of potatoes in distilleries and profitable use of the waste products of the process for feeding. The question of manufacture of starch, dextrin, glucose and evaporated potatoes, is a closed book to Canada, but it is hoped to open it some day.

The chapters on origin and the botany of the potato are interesting enough, though it does make little difference whether it was Drake or Raleigh who brought the potato first to Europe. The original home, we may accept, is South America—Chili as likely as Peru.

In discussing the quality of seed potatoes, the author agrees that a strict and properly executed system of certification is the best safeguard. The question of size of seed is interesting. The use of whole seed yielded per ounce 3.76 oz., eye ends only, per oz. 6.81 oz., cut lengthways per oz. 5.93 oz., and stem end per oz. 5.08 oz. (I am taking the liberty of placing the decimal points, omitted in the book by error).

In regard to treatment of seed before planting, I thoroughly agree with the author—he, as well as others, is not always successful. Seed treatment certainly affects, at the best, only surface born germs not disease within the tuber is controlled; then add the important factor of disease germs in the soil and the trouble and expense in carrying out the treatment. Who will have enough "nerve" or courage in Canada to come out and say:—"Don't bother treating your seed potatoes"? The chapter on diseases is naturally of great interest to me. It is a little disappointing to the Canadian reader, but we do agree that Germany is much behind the time in spraying for the control of Blight, as well as in the extensive application of control measures generally—let us hope they do not require it. It is also remarkable to a reader on this side of the Atlantic to note how primitively, on the whole, the matter of preparation for shipping and shipping itself, is dealt with in a country, otherwise a leader on the subject. It is a gratification to know of our laws governing the sale of potatoes in Canada, and the effective man-

ner, in which we dispose of our crop for export or domestic use. A visit to Canada would be a revelation to Dr. Remy in this regard. For this reason alone, some of the illustrations might better have been left out (Fig. 51-56) but perhaps I lack the necessary sense of humor to appreciate same—

Let this suffice—.

The rest of the book is equally instructive and the author should arrange for an English translation—everyone on this Continent would profit from a close study—potato growers, animal and field husbandmen, etc. It is a most valuable book, with few defects, if any, and the author may be assured that he will be appreciated by all who will take the trouble to read his book in the German language.

H.T.G.

THE POTATO, ITS HISTORY, VARIETIES, CULTURE, AND DISEASES, McIntosh, Thomas P. 8vo, 264 pages, 38 illustrations. Printed and published in Great Britain, 1927. Oliver and Boyd, Edinburgh and London. 12/6d net. Canada, Macmillan Company, Toronto, $3.40.

The book is conveniently arranged in five parts, each part complete in itself, as follows:— Part I—Historical, Part II—Botanical, Part III—Reproduction and Propogation, Part IV—Cultivation and Utilization, Part V—Diseases, Pests and Injury. 33 Chapters in all.

The preface is by Professor J. A. S. Watson, School of Rural Economy, Oxford, and in addition to the Author's Note and Introduction, there is an Appendix, Descriptive notes of some common commercial varieties, Glossary and Index.

McIntosh has had wide experience on potato production problems in the British Isles, and is intimately connected with the certification of Scottish seed potatoes and the potato work of the Board of Agriculture for Scotland. Potatoes are one of the two important foodstuffs in regard to which the British Isles are still self-supporting.

Much of the more recent knowledge concerning potato diseases, varieties, and culture, lies scattered in scientific journals, and other publications, that are not readily accessible to the potato grower. The aim of the author has been to assemble such information, to which he has added much that is new, in a concise readable form adapted to a wide range of readers. This volume will be welcomed by the teacher and student of agriculture, as well as by the practical grower and merchants, for the scientific and sound practical information contained therein.

Chapters 1—2, refer to the Origin, Early History, and Development of the Potato and a Historical Note on Some Varieties and Breeders.

Chapters 3—9, The Systematic Position of the Potato and Notes on Some Wild Species of Tuber-bearing Solanums. The Potato Plant. The Classification of Varieties. Intervarietal Differences of the Potato Foliage, The Floral parts, The Tuber, Sprouts and Stolon. The Maintenance of Pure Stocks.

Chapters 10—14, Breeding and the Application of Genetics to Variety Raising. Propogation and Variation.

Chapters 15—17, Cultivation, Manuring, Utilization.

Chapters 18—33, Diseases, Pests and Injury.

Primarily intended for readers in Great Britain and Ireland, the book also contains information useful to the agricultural student and potato grower in Canada, more especially the methods used in determining the intervarietal differences, which can be applied to varieties grown in Canada. The chapters on potato diseases are very short; no attempt is made to include more than a short descriptive outline of the more common diseases found in the potato crop in Great Britain, the economic importance and suggested control.

J. T.

CONCERNING THE C.S.T.A.

Victor Matthews

Victor Matthews, Superintendent of the Dominion Experimental Station, Scott, Sask., a charter member of the Society, died with tragic suddenness on the evening of February 15th. The cause of death was acute endocarditis. He had performed his official duties as usual during the day, had been cheerful at his evening meal and had left home about 7 o'clock to curl. He spent half an hour with the Experimental Station clerk on his way to the curling rink and at 7.45, when he left the clerk's room, appeared to be in his usual good health. At 8.15 he was picked up a short distance from the rink. Medical attention was immediately obtained but life was pronounced extinct. The funeral was held at Scott on February 17th, following the arrival of his brothers Douglas and Harold.

Born in Newfoundland on April 15th, 1890, Victor Matthews was in his 38th year. He graduated from Macdonald College in 1913 and immediately afterwards was appointed Assistant Superintendent of the Dominion Experimental Station at Lethbridge, Alta. He remained there until 1924 when he was appointed Superintendent at Scott, a position which he filled with exceptional credit until the time of his death.

The attention of members is directed to the fact that nominations for the four Dominion officers (President, Vice-presidents and Honorary Secretary) for the year 1928-29 are not valid if received after March 15th. Nominations may be made at any local branch meeting or signed by any ten members in good standing. On March 15th, following the receipt of nominations, the election ballot will be prepared. This ballot will be mailed to all regular members on April 10th.

Notes and News.

W. F. Hanna (Alberta '22) is Assistant Plant Pathologist at the University Farm, St. Paul Minn., U.S.A., where he is completing post graduate work towards his Ph.D.

J. W. Lemyre (Montreal '21) is now Official Agronomist for the Counties of Laval and Jacques Cartier, P.Q. His new address is 10830 St. Denis, Ahunstic, Montreal, P.Q.

C. A. Lamb (British Columbia '21) has been appointed Assistant in Agronomy at the University of British Columbia, Vancouver, B.C.

Alexander Maclaren (Toronto '09) has changed his address to Glenbrae Farm, Georgetown, Ontario.

Luc Duval (Laval '22) has changed his address to 3462 Laval Avenue, Montreal, P.Q. He is representing the American Agricultural Chemical Company.

C. McK. Collins (McGill '22) is spending a few months in the market district of Boston acting as salesman for Isaac Lock & Co., Wholesale Fruit & Produce Dealers, Boston. His address is 25 Brook Street, Brookline, Mass., U.S.A.

J. H. McCulloch (Toronto '16) has changed his address to 129 Edna Avenue, Toronto 9, Ontario.

Applications for Membership.

The following applications for regular membership have been received since February 1, 1928:—

James R. McFall, (Alberta, 1927, B.S.A.), Etzikom, Alberta.

Fred. Richardson, (Toronto, 1926, B.S.A.), Poultry Husbandry Department, Ontario Agricultural College, Guelph, Ontario.

W. C. Hopper (Toronto, 1920, B.S.A.), Field Husbandman, Central Experimental Farm, Ottawa, Ontario.

Eighth Annual Convention, C.S.T.A.

Owing to the extensive tourist traffic to the City of Quebec in the summer months, it is imperative that those who intend to be at the next Convention of the C.S.T.A. should make reservations through the General Secretary. The Convention programme will not be available before the middle of May, after which date it will not be possible to insure accommodation. The Chateau Frontenac, where the Convention will make its headquarters, must be advised of the Society's requirements at an early date. Members will be wise to communicate with the General Secretary as soon as possible, giving full information as to their wishes.

The dates of the Convention are June 11th to 14th, inclusive.

NOS RAISONS CLASSIQUES D'AIMER L'AGRICULTURE*

Monseigneur Camille Roy†

J'ai accepté avec plaisir l'invitation que m'a faite de venir causer ici Monsieur le Président de la Section de Québec de la Société des Agronomes Canadiens.

Il m'était fort agréable de venir rencontrer autour de cette table de famille les agronomes, de mêler un moment de ma vie avec celle de ces ouvriers très diligents, nécessaires, de la prospérité agricole de la province de Québec.

Ce m'est une grande joie aussi et un honneur d'apporter ici mon hommage personnel à celui qui est votre hôte d'honneur, qui est votre chef et votre créateur; l'honorable M. J.E. Caron, Ministre de l'Agriculture.

Votre créateur, il l'est assurément, puisque c'est lui qui a fait surgir dans cette province les agronomes et organisé leurs services; c'est lui qui a coordonné vos forces, qui a jeté à travers nos campagnes votre armée pacifique d'instructeurs, de conseillers, d'organisateurs, chargés de coopérer avec nos braves habitants, d'améliorer leurs méthodes de travail et leurs conditions économiques.

Pour cette seule création, l'honorable ministre aurait déjà hautement mérité de nos classes agricoles, de tout notre peuple. Mais cette création ne fait que s'ajouter à tant d'autres oeuvres dont s'est remplie sa laborieuse et féconde carrière.

MM. les Agronomes, vous êtes, et vous resterez l'une des oeuvres les plus bienfaisantes de son ministère; et vous formez ce soir autour de lui une couronne précieuse dont il est fier.

Ce soir, vous l'avez prié d'être votre hôte d'honneur. Vous avez voulu ainsi lui exprimer votre reconnaissance. Cette reconnaissance, elle est partagée par tous les agriculteurs pour lesquels se dépense depuis tant d'années le zèle fervent de l'honorable ministre; par tous les agriculteurs pour lesquels vous travaillez vous-mêmes, pour lesquels vous existez, et qui bénéficient de vos si utiles concours.

Voilà donc de premiers et d'excellents motifs de me trouver avec vous ce soir et près de votre hôte d'honneur.

J'en ai d'autres.—Il y a la cause que vous représentez, à laquelle vous vous dévouez: la cause de l'Agriculture. Cette cause m'est personnellement chère; elle est chère à notre Séminaire de Québec et à l'Université Laval; elle fait partie de leurs activités classiques; cette cause de l'Agriculture, elle est l'oeuvre essentielle, vitale, de notre province de Québec.

* * *

Oui, c'est une voix bien familière, qui me persuadait de venir vers vous ce soir: la voix du sol, de la bonne terre canadienne.

*Causerie au diner offert à l'honorable J. E. Caron par la Société des Agronomes Canadiens, Section de Québec, le 14 Janvier, 1928.

†Ex-recteur de l'Université Laval.

J'appartiens à une dynastie rurale qui depuis 1660 n'a jamais cessé de défricher, de labourer, de semer, de vivre de la terre.

Mes premiers souvenirs d'enfance sont des souvenirs de la vie des champs: ils se confondent avec des visions de labour, de prairies vertes et de blés mürs.

Aux premiers sourires de ma mère se mêlent les sourires de la terre natale; de la terre à qui nous demandions la vie matérielle, et qui nous offrait, par surcroît, l'image gracieuse de ces champs fertiles, et de ces côteaux modérés.

Qui a vu les côteaux rouges de Berthier, les terres d'alluvion qui s'étendent à leur pied, ou celles-là, moins grasses, mais élégantes, qui en prolongent les sommets, et le fleuve large, splendide, qui les borne, qui les enveloppe de sa rumeur harmonieuse, qui y ajoute le spectacle de sa vie marine: qui a vu cela comprend comment à Berthier on peut aimer la terre et s'y attacher pour toujours.

Je suis donc un terrien, un fils de cultivateur, de laboureur du sol. J'ai moi-même versé sur ce sol que j'ai travaillé, mes premières sueurs—j'aimais mieux alors en arroser la terre que les livres—j'ai gardé de cette vie agricole qui fut ma première vie un souvenir précieux que je me plais toujours à évoquer et qu'il m'est doux, ce soir, de faire revivre avec vous.

* * *

Mais ceux qui m'ont fait l'amabilité de m'inviter à causer ici, m'ont aussi confié qu'ils étaient désireux de voir l'Université Laval que je représente, appuyer de son prestige et de son action, l'oeuvre si importante de l'agriculture.

Messieurs, l'Université Laval a toutes les raisons de ne pas rester étrangère à votre oeuvre, et de la seconder de son influence et de ses efforts.

Elle est issue du vieux Séminaire de Québec. Par lui elle plonge ses bases profondes au sol où fut tracé le premier sillon de Louis Hébert.

C'est sur la propriété même de Louis Hébert que sont établis notre Séminaire et l'Université: on le sait si bien que des descendants lointains et jaloux de notre premier laboureur nous en contestent encore parfois la propriété! Mais le Séminaire et l'Université, fiers et forts de leur titre de possession, continuent de se glorifier du sol historique qui les porte: et là où ne peuvent plus germer les blés, ils sèment des idées, ils sèment de la pensée, de la verité, de la science. La jeunesse accourt vers ces sillons toujours nouveaux; elle s'en nourrit; elle y fait croître pour l'avenir de notre race, ses plus hautes espérances.

Nous sommes donc, autrement que Louis Hébert, des semeurs: mais nous semons, comme lui, du bon grain; et nous travaillons, comme lui, pour la prospérité de la patrie commune.

C'est pourquoi l'Université, qui sait tout le prix de l'agriculture, et tout le prix de notre science agricole, est fière de s'affilier les maisons où on l'enseigne. Parmi les collèges qui ont bien voulu se grouper autour d'elle,

elle compte l'Ecole d'Agriculture de Ste-Anne de la Pocatière. A cette école vont ses vives sollicitudes, et elle est toujours heureuse de contribuer, dans la mesure où cela lui est possible, à ses progrès. Mais c'est aussi par ses collèges classiques affiliés que l'Université s'efforce de créer de l'estime pour la profession agricole et une plus juste appréciation de l'agriculture.

Il fut un temps où un jeune homme aurait cru déroger, si après ses études classiques faites avec soin et succès, il s'était fait agronome, agriculteur ou laboureur. Il n'en est plus ainsi: et chaque année, nous voyons des lauréats du cours classique, des bacheliers ès arts se diriger vers l'Ecole d'Agriculture pour s'y spécialiser dans la science des agronomes.

L'Ecole est fière de recevoir ces recrues de qualité supérieure; et l'Université est fière aussi de les lui confier.

Ici encore, elle peut se rappeler avec orgueil que l'illustre, le vénérable évêque dont elle porte le nom, Monseigneur de Laval, créa lui-même, vers 1670, la première école d'agriculture de ce pays. On sait en effet que l'Ecole des Arts et Métiers de St-Joachim, établie sur les fermes qui s'étendent fertiles et magnifiques, au pied du cap Tourmente, appliquait ses élèves à l'art et au travail de l'agriculture.

Monseigneur de Laval avait bien compris lui-même que l'agriculture était la richesse certaine sur laquelle il fallait édifier la colonie nouvelle; et il voulut assurer à la profession d'agriculteur non seulement des bras solides, capables de vigoureux efforts, mais des têtes instruites, des esprits capables de procurer à l'exploitation du sol les nécessaires progrès.

* * *

L'Université, les collèges classifiques, d'ailleurs, ne trouvent-ils pas dans les études mêmes auxquelles ils appliquent leurs élèves, des motifs et des occasions d'honorer et de servir l'agriculture?

Les lettres classiques où se forme l'esprit des étudiants, sont toutes pleines des souvenirs et des éloges de l'agriculture.

A l'origine même de la littérature et de la civilisation grecque, c'est Hésiode, le poète paysan de la Béotie, qui convie aux travaux des champs ses lecteurs et ses compatriotes. Ses compatriotes, il les personnifie dans son frère Persès auquel s'adressent ses exhortations. Il les veut détourner de la chicane—on dirait aujaurd'hui du barreau—, de la place publique, des discussions des triburaux, pour les occuper aux soins de l'agriculture.

L'humanité, leur rappelle-t-il, n'est plus à l'âge d'or où "les hommes vivaient comme les dieux, le coeur libre de soucis, loin du travail et de la douleur. . . La campagne fertile leur offrait alors d'elle-même une abondante nourriture. . ."

Il pense que l'âge de fer est celui de l'humanité actuelle, et que pour y vivre, il faut travailler et qu'il y faut savoir travailler. De là tous ces préceptes agricoles que donne Hésiode à Persès,—préceptes que l'on a bien précisés et heureusement complétés depuis: vous avez aujourd'hui des maî-

tres plus avertis qu'Hésiode—préceptes qui déjà enseignent toute l'estime qu'il faut avoir pour l'agriculture.

Nos cultivateurs d'aujourd'hui, comme ceux du temps d'Hésiode, du 8ème siècle avant J.-C., pourraient entendre avec profit le conseil pratique et pressant du travail consciencieux qui seul rapporte bien et donne la fortune au travailleur:

> "Travaille avec tant d'ardeur que la faim te prenne en haine, et que Déméter à la riante couronne remplisse tes greniers."

Plus tard, bien plus tard, au siècle de la poésie alexandrine, au 2ème siècle avant J.-C., un autre poète grec, Théocrite, le créateur de la poésie pastorale, chantera la vie des pâtres et des laboureurs. Il ne leur donne pas de préceptes. Il se contente d'idéaliser leur vie, de répandre de la grâce et de la beauté sur les scènes familières qu'il raconte, et de rappeler que là, aux champs, près des vignes, des troupeaux et des blés, on trouve la joie profonde, la prix inaltérable, le meilleur bonheur de la vie.

Et vraiment, Messieurs, à ce point de vue, les poètes idylliques ne sont pas inutiles. Il n'est jamais inutile de faire bien comprendre au laboureur, à l'homme des champs, que sa vie laborieuse comporte dans les joies saines, réconfortantes qu'elle lui procure, et dans la beauté trop souvent inappréciée de son travail, sa première et sa plus solide récompense.

Les latins qui, en littérature, ont si souvent recommencé les grecs, n'ont pas manqué de reprendre ces beaux thèmes de vie rustique, avec lesquels ils ont fait des chefs-d'oeuvre que traduisent avec un effort pas toujours assez joyeux nos écoliers.

Vous souvient-il de Virgile, de ses Eglogues et de ses Géorgiques? Si Virgile s'est surtout appliqué dans les Eglogues ou Bucoliques à couvrir de poésie très douce, et parfois mélancolique, les prairies du Mincio, et à peindre des sènes aimables de la vie des bergers, et si, dans les *Géorgiques,* il a repris avec plus de sincérité l'éloge de la campagne, il faut retenir qu'il a joint dans cette dernière oeuvre, aux grâces de la poésie, l'utilité des préceptes.

Les Géorgiques sont à la fois un poème et un manuel d'agriculture. Ce manuel a sûrement été dépassé lui aussi par nos modernes préceptes; mais il laisse encore dans l'esprit et l'imagination du jeune humaniste une impression de vérité et une leçon de beauté qui attachent à la bonne terre, et contribuent à répandre son culte.

N'est-ce pas lui, Virgile, qui a écrit, au livre deuxième des Géorgiques, en commençant l'éloge de l'agriculture, ces vers que vous-mêmes, à votre insu parfois, tant ils expriment une vérité commune, vous ne cessez de répéter en variables formules à vos laboureurs:

> "O fortunatos nimium, sua si bona norint, Agricolas!..."
> "O trop heureux, s'ils connaissaient les biens dont ils jouissent, les laboureurs! Les laboureurs à qui la terre bienveillante... livre elle-même la facile abondance de ses produits!... Ils ont la sécurité paisible, ils ont cette vie qui ne sait pas tromper, des ressources

variées et riches, le repos dans les vastes campagnes, les grottes, les lacs aux eaux vives, et les mugissements des boeufs, et les doux sommeils sous l'ombre".

"Mugitusque boum, mollesque sub arbore sumni..."

L'on a besoin de redire à l'homme des champs ces pensées et ces vers du poète, puisqu'il n'est que trop vrai que le laboureur est de tous les hommes celui qui ignore le plus les biens dont il jouit, et son propre bonheur.

* * *

Mais je m'excuse d'être allé si loin, dans la littérature classique, chercher nos raisons universitaires d'aimer l'agriculture.

Ce sont de vieilles habitudes de professeur qui s'éveillent ici ce soir, où je revois autour de ces tables de chers anciens élèves—sous-ministre, députés, agronomes—; habitudes qu'ils connaissent bien, et qui m'ont entraîné si loin et si haut dans le passé, jusqu'à ces lettres gréco-latines qu'ils ont tant aimées!

Au reste, il n'est pas inutile de nous rappeler, entre agronomes et fils de cultivateurs, tous les titres classiques de la noblesse du sol, et les éloges qui, à travers les siècles, ont célébré la bonne terre et ses travilleurs.

Si maintenant, de nos lointains ancêtres intellectuels je descends jusqu'à nos écrivains et jusqu'à notre littérature canadienne, je retrouve chez-elle et chez eux la même préoccupation de créer de l'estine pour le laboureur, pour le colon, pour la profession nourricière du peuple.

Ai-je besoin de vous rappeler ici Jean Rivard de Gérin-Lajoie? Ce roman qui parut en 1862 et '64, et qui fut l'une des premières manifestations importantes de notre vie littéraire?

Jean Rivard, ce fut vraiment le roman du colon, du défricheur, du cultivateur, de l'habitant canadien. Il parut à une époque où l'on sentait le besoin de retenir chez-nous, à notre terre fertile et à nos forêts vierges, les jeunes qu'attirait l'industrie américaine, et qui trop nombreux franchissaient la frontière pour aller donner à nos voisins des énergies nécessaires à notre vie nationale. Et ce livre prouve une fois de plus que la littérature d'un peuple réflète nécessairement sa vie, et que la nôtre sut presque toujours traduire nos plus essentielles préoccupations.

Et comme le livre de Gérin-Lajoie est vraiment rempli de vie canadienne! Et comme il déborde de tendresse pour la terre maternelle! Et comme il raconte avec soin nos plus anciennes et nos plus chères traditions! Et comme il donne au lecteur le goût de la vie simple, joyeuse, active et calme, laborieuse et paisible de la vie des champs!

Et comme je voudrais que pour tout cela et pour toutes ces raisons Jean Rivard fût distribué à profusion comme livre de récompense dans nos écoles des compagnes. Il serait à lui seul un merveilleux conférencier agricole, et un persuasif apôtre de la cause de l'agriculture.

Je ne puis m'empêcher de vous rappeler encore ici une oeuvre littéraire de chez-nous, qui est toute pleine d'agrestes parfums, et qui est un sincère

hommage à la vie des champs: je veux parler de l'oeuvre de notre très doux poète, Pamphile Lemay. Il a versé dans son oeuvre toute la poésie de Lotbinière, tout le soleil de nos printemps, toute la gaieté de nos hivers, toute l'abondance de nos étés, toutes les couleurs de nos automnes: et avec quel amour il a voulu rendre plus fervent, dans nos campagnes, le culte de la terre, et le culte du foyer! Lisez Tonkourou; lisez aussi les sonnets rustiques de ses Gouttelettes!

Et parmi ces sonets, ceux-là qu'il a consacrés aux travaux des champs; au sol, au labour, aux semailles, aux blés, à la grosse gerbe.

Il a chanté le semeur qui

"... puise le grain d'ambre au sac de toile fauve,
Et, d'un geste rythmé, le répand au sillon.
. . . . . .
Donne au sol le froment, Quand le jour aura fui,
Entre, vaillant semeur, dans ta chambrette close...
Donne au sol le froment, au foyer l'enfant rose."

Et il y a de Lemay le sonnet du Colon, petite pièce classique où en quatorze vers tient tout ce tableau: la forêt qui chante, la forêt qui tombe, la forêt qui fait place aux champs labourés et aux blés mûrs.

On sait combien notre littérature toute contemporaine a voulu se faire aussi agricole: comment elle est devenue, en prose ou en poésie, littérature du terroir; et comment, s'inspirant du terroir, elle s'est proposée de raconter, de peindre, de célébrer la compagne, ses traditions, ses ouvriers, ses champs, leur richesse, leur beauté. Notre littérature du terroir a voulu faire mieux aimer le chez-nous rural et rustique: elle est devenue comme une agence active et séduisante du Ministère de l'Agriculture.

Avec les agronomes, nos écrivains voulent se faire dans nos campagnes, des collaborateurs efficaces du ministre, et transformer en fructueuses réalités ses rêves de patriote.

* * *

C'est que, Messieurs les Agronomes, vous représentez une cause qui doit, dans cette province, rallier tous les suffrages, et tous les esprits: et ceci n'est pas la moindre de nos raisons classiques de servir avec zèle l'agriculture.

Je ne répéterai pas après tant d'autres, que l'agriculture est pour notre race canadienne-française la richesse essentielle de notre vie.

Enracinée au sol depuis plus de trois siècles, notre race y puise sa meilleure sève, et elle doit continuer d'y chercher sa force et sa fécondité.

Certes, nul ne conteste l'opportunité des industries nécessaires au plein rendement de notre capital national; il faut qu'elles existent et qu'elles augmentent elles aussi notre richesse publique. Mais notre peuple, qui a vécu sur le sol les heures les plus difficiles de notre histoire, qui par le sol a triomphé de tous les dangers qui menaçaient sa survivance ethnique ou

morale, ne retrouvera toujours que dans la possession et la culture du sol les éléments les plus certains de sa fortune.

Mais pour que notre peuple aime les ol, s'attache aux champs qu'il cultive, il lui faut savoir comment il doit bien cultiver, par quels moyens plus méthodiques et plus efficaces il peut s'y assurer une aisance nécessaire.

On a dit au cultivateur qu'il est roi sur sa terre. Mais notre cultivateur ne veut pas seulement régner, il veut être un roi heureux. C'est à vous, Messieurs les Agronomes, de contribuer à son bonheur, de lui enseigner, avec l'art de cultiver, les moyens d'être plus heureux.

Trop longtemps la routine a rendu trop improductrice la bonne terre du cultivateur. C'est à vous de l'aider à rompre avec les routines stériles et à rendre plus fertiles ses champs.

Je sais avec quel zèle vous vous y employez.

Pendant l'année 1926-27, vous avez fourni un bilan qui fait votre éloge: 1,756 conférences, 2,758 démonstrations, 85,561 visites: sans compter la littérature abondante et précieuse de vos 58,757 lettres et de vos 13,709 brochures distribuées!

Voilà une littérature du terroir qui rapportera, peut-être peu de fleurs, mais surement du meilleur et du plus pur froment!

On a bien constaté, ces jours derniers, les résultats pratiques de votre travail quand on a vu accourir, pour les cours d'hiver, à l'Ecole d'Agriculture de Ste-Anne de la Pocatière, par centaines, et plus que ne pouvait en contenir l'Ecole, les jeunes fils de cultivateurs qui voulaient apprendre à mieux cultiver.

Ce fait, qui alarma le directeur de l'Ecole, incapable de recevoir tous les étudiants, est un signe heureux d'une transformation qui se fait—et dans une bonne mesure, grâce à vous—dans l'esprit et la mentalité des agriculteurs. On croit plus qu'autrefois à une science de l'agriculture.

La création des jardins scolaires a contribué à développer chez l'enfant des campagnes, avec l'amour de la terre, le goût de la science agricole.

C'est ce goût que l'agronome a la mission de répandre, de faire plus intelligent et plus curieux. L'indifférence pour l'agriculture dans l'école des campagnes, et dans l'esprit des fils de cultivateurs, est un mal qu'il faut redouter, et un mal qu'il faut corriger.

Ce mal contribue, pour sa part, à une émigration des jeunes vers la ville, qui a déjà causé trop de dommages à notre agriculture.

Messieures les Agronomes, je suis sûr que M. le ministre de l'Agriculture est tout heureux de vos inappréciables services, de vos activités et de leurs résultats, et... de votre littérature.

L'Université Laval aussi ne peut que s'en réjouir. Elle suit avec le plus vif intérêt les développements, les progrès des Ecoles d'Agriculture.

Elle fait et couronne avec prédilection les bacheliers du sol; elle voudrait que se fortifie de plus en plus votre nécessaire et belle Association des Agronomes Canadiens.

Votre Association vous groupe pour un meilleur effort d'enseignement, de propagande et de progrès.

Vous êtes nécessairement, sous la direction du ministre de l'Agriculture, les instruments indispensables de cet enseignement, de cette propagande, de ces progrès; mais vous le serez avec plus ou moins de zèle et d'efficacité selon que vous vous associerez pour mieux étudier ensemble nos problèmes agricoles, la science agricole, et pour mettre en commun vos particulières expériences.

S'unir pour une telle fin, c'est créer de la force.

Et je puis vous assurer que si, à l'occasion de vos travaux et de votre apostolat, vous avez besoin quelquefois du concours, de l'appui de l'Université, celle-ci estimera, en vous assurant cet appui et ce concours, qu'elle reste fidèle à qui l'a créée, et à la mission publique qui lui est confiée.

C'est parce que l'Université Laval veut coopérer avec toutes les forces constructives de notre vie nationale, qu'elle ne peut pas se désintéresser de vos travaux. C'est parce qu'elle apprécie l'oeuvre excellente que vous avez déjà accomplie, et le dévouement inlassable, éclairé, de l'honorable M. Caron, du ministre que vous a créés, et qui, en vous créant, a fait oeuvre de paternité providentielle, que je suis venu ici la représenter, et vivre avec vous, ce soir, une heure délicieuse de ma vie.

NOUVELLES

C'est avec un bien vif plaisir que les membres de la C.S.T.A. ont appris l'honneur récemment conféré à leur confrère, monsieur Narcisse Savoie, Secrétaire du département de l'Agriculture de la province de Québec et Chef du Service agronomique, qui a reçu le titre d'Officier du Mérite agricole.

La satisfaction ressentie s'est immédiatement manifestée par la résolution de la Section de Montréal, qui a demandé au nouveau décoré de bien vouloir être l'hôte d'honneur du prochain déjeuner-causerie, dont la date définitive sera annoncée sous peu. De son côté, la Section de Québec prit l'initiative d'organiser un diner en l'honneur de monsieur Narcisse Savoie, qui a déjà eu lieu le 21 février, au restaurant Kerhulu, à Québec.